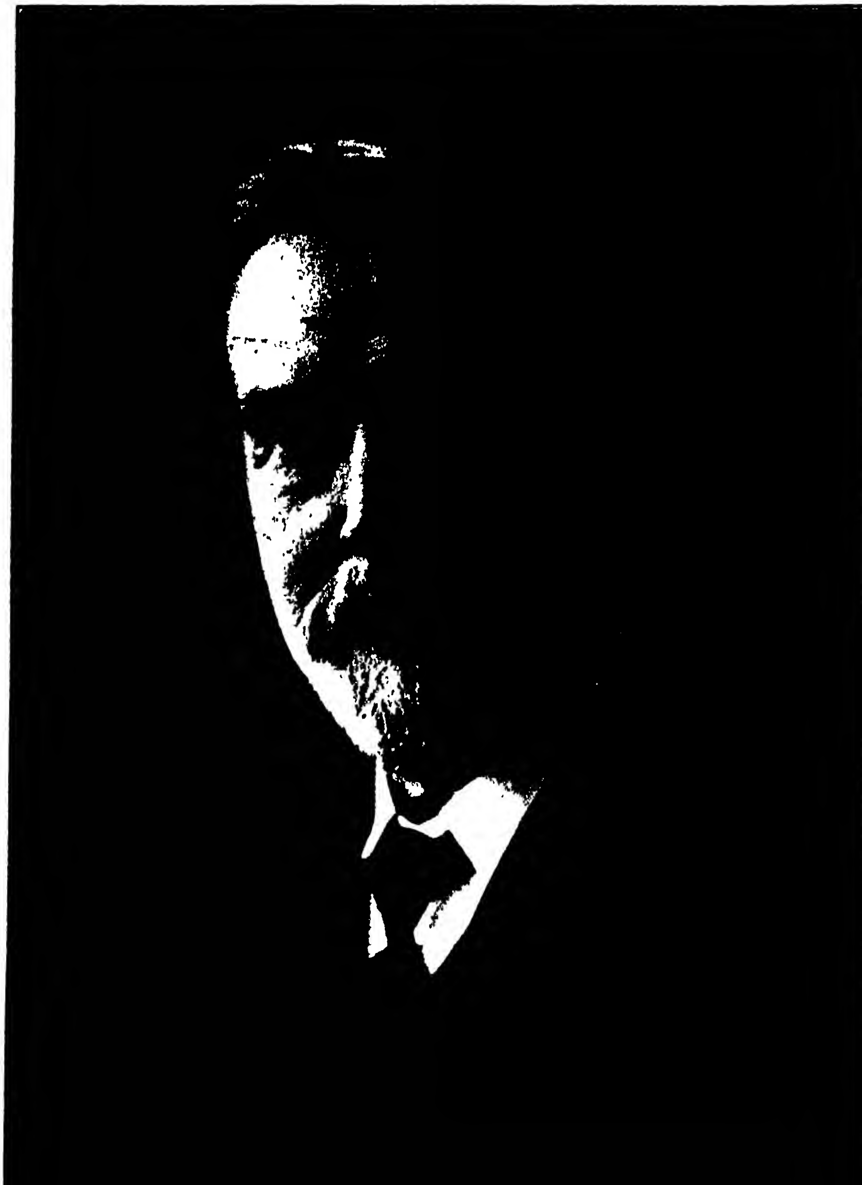

THE LATE SIR JOSEPH C. VERCO, M.D., F.R.C.S.

TRANSACTIONS AND PROCEEDINGS

OF THE

ROYAL SOCIETY OF SOUTH AUSTRALIA

(INCORPORATED)

VOL. LVII.

- LVIII

[With Portrait, Ten Plates, and Thirty-two Figures in the Text]

EDITED BY PROFESSOR WALTER HOWCHIN, F.G.S.

[*Each Author is responsible for the soundness of the opinions given, and for the accuracy of the statements made in his paper.*]

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CONTENTS

ERRATUM

Page 142, for *crosus* Lam. read *crosus* Lam.

OBITUARY NOTICE.

SIR JOSEPH VERCO (1851-1933)

WITH PORTRAIT AS FRONTISPIECE.

Joseph Cooke Verco was born at Fullarton, S.A., on August 1, 1851. Both his parents were Cornish, as, it is interesting to note, were those of a great contemporary physician, Sir William Osler, Bart. (1849-1919), another colonial who was born and educated in Canada. Sir Joseph began his formal education at a well-known Adelaide school of last century conducted by John Lorenzo Young, an outstanding teacher and one of the foundation members of what later became the Royal Society. On leaving school, Sir Joseph spent twelve months in the service of the S.A. Railway Department, his ambition being to be able some day to write the mystic letters "C.E." after his name, but, as he learnt after a year's drudgery copying statistics in the office, the training he could get there was too primitive to lead to his success in the engineering profession, and he therefore decided to qualify for the medical profession. To brush up his classics, he attended St. Peter's College and, in 1869, won its coveted Young Exhibition, a valuable prize awarded to the best scholar of the year.

Early in 1870 he left Adelaide and began his medical studies in London. In 1875 he gained the M.B. degree at the University of London, and its two medals, one for his success in forensic medicine and the other in medicine; next year he secured its M.D. with the medal for proficiency in all subjects; and in 1877 its B.S. with medal. Some years ago Sir Joseph presented these four handsome gold medals to the Public Library. They are exhibited in the Coin Room, where they may be seen by any visitor interested in the academical triumphs won by an Australian student in the '70's of last century. In 1874 he gained the distinction of M.R.C.S. (Eng.), and three years later was advanced to its F.R.C.S. In 1875 he became L.R.C.P. (Lon.). His medical studies were made at St. Bartholomew's Hospital, and in 1876 he was appointed its House Physician, and in 1877 its Midwifery Assistant.

His connection with the venerable hospital occurred at a time of great importance in the history of surgical treatment; for when he entered it as a student, the cardinal discoveries that the genius of Lister had successfully applied at Edinburgh were condemned at "St. Bart's," but before he left it they were blessed. In 1923, its 800th anniversary was celebrated, and Sir Joseph Verco received a special invitation to join in the ceremonies. He, with Lady Verco, went to London, and after an absence of nearly half a century, he was able to revive his impressions of his old medical school.

In 1878 he returned to South Australia and began practising his profession in Adelaide. A few years later he was recognised as its leading physician, a distinction that he retained until his retirement in 1919. It is difficult to summarize his many medical and philanthropic activities during his half century of active life in Adelaide. For several years he was Hon. Physician to the Adelaide Children's Hospital and later became its Hon. Consulting Physician. For thirty years (1882-1912) he was Hon. Physician to the Adelaide Hospital, and on his retirement became its Hon. Consulting Physician. He took a great interest in the formation of the Medical School of the Adelaide University, and from 1887 to 1915 was its Lecturer on Medicine; was Dean of its Faculty of Medicine, 1919-21; and Dean of its Faculty of Dentistry in 1921. He was a member of the Council of the University from 1895-1902, and seventeen years later was again elected and remained on the Council until his death. In 1886-7 he became President of the branch of the British Medical Association in South Australia, and from 1914

to 1919 he filled the same distinguished position. On his retirement he was created a Knight Bachelor.

He was President of the first Intercolonial Medical Congress at its Adelaide meeting in 1887, when he delivered a striking address, widely reported in the Press of that day, dealing mainly with the reaction of the Australian environment on the descendants of Europeans. His medical publications include the important chapter "Hydatid Disease," contained in Allbutt & Rolleston's *System of Medicine* (vol. iv., 1907). In 1926 he presented to the University the sum of £5,000 for the purpose of publishing medical investigations in "The Australian Journal of Experimental Medicine and Medical Science."

"My interest in shells began when I was quite a lad and made a museum in the back yard of our home in Morphett Street, Adelaide. Shells, I thought, were more desirable to collect than insects, less liable to explode than birds' eggs and not quite so easily broken." These words are taken from a fragment of autobiography written by Sir Joseph to explain his interest in malacology, his favourite hobby, on which he spent much time and money and greatly advanced the knowledge of marine life along the Australian coasts. Fortunately, when as a lad he began his elementary studies, there was a collection of South Australian shells in the embryo S.A. Museum exhibited in a room above the Newspaper Room of the Public Library. These shells had been probably named by F. G. Waterhouse, the then Curator, and young Verco found them a useful guide in naming his own collection. His greatest treat, he wrote, was on school holidays to find his way to the Semaphore, then a row of uninhabited sandhills, and scour the beach for shells. But the schoolboy's passion for collecting was inhibited by the year he spent in the Railway Department, followed by another year at St. Peter's College, and then seven years in London medical schools; when he returned to begin practising his profession in Adelaide, the juvenile museum in the back yard had certainly, and the young man's interest in shells had apparently, vanished. About 1887 he suffered from an attack of enteric, and when he became convalescent his cousin, Dr. S. J. Magarey, invited him to stay for a few days at Glenelg. There Dr. Verco spent many hours walking along the sandy beach north of the Patawalonga Creek, and his interest in shells revived. To complete his convalescence he took a trip to New Zealand, and there gathered a large assortment of shells. They were brought back to South Australia and the more showy ones installed in a glass cabinet and exhibited in the Doctor's waiting room. The ailment that he once humorously described as "conchylophobia" now held him in thrall. His eldest brother, Mr. W. J. Verco, was a wheat merchant who owned several ketches that were used to bring wheat from the outports to Port Adelaide. For several consecutive years Dr. Verco had one of the ketches lent to him, and usually, with some of his nephews, he spent a week or more dredging for shells in the gulfs and bays of the State. Defects in the dredging apparatus were carefully noted and remedied for the next trip; not only were shells taken, but also corals, crabs, sea urchins, sponges, and other forms of marine life. The technique of preserving them was mastered, and they were forwarded to the experts in the various departments of the S.A. Museum and to collectors in other States. Space cannot be spared to give even a list of various dredging trips that became his regular form of recreation. He has left a manuscript account of these excursions, written at the time each was made, and containing a description of the hauls, as well as kindly and humorous comments on the events that occurred on board. If some day these are published, they will be found to be of scientific as well as general interest to many readers. Several times he hired a seaworthy tug and, with some co-workers interested in marine life, spent sometimes ten or twelve days dredging in the deeper waters covering the continental shelf off the Great Australian Bight. The expenses, wholly defrayed by Sir Joseph, were considerable, but the results

were of great value to marine biology. His interest in the study of shells brought him into communication with similar workers in other parts of the Commonwealth; as time passed, some of these died and he purchased their collections and embodied them in his own. For many years he was Hon. Conchologist to the S.A. Museum, and his services in that capacity were invaluable. When in 1919 he released himself from the practice of his profession he spent many hours daily at the Museum; and when bodily weakness compelled him to relinquish this work of love, he presented to the Museum his valuable collection of shells and the cabinets containing them, as well as his conchological literature, comprising volumes in English, French, and German, some of them very rare and costly. His shells were catalogued with meticulous care; with each species was a sheet of specially made paper containing not only the technical descriptive matter but a summary of its distribution in space and time, and full references to literature and all important discussions of nomenclature and synonymy. It is a marvel of compression, and is capable of being added to when new information is available. It was a munificent gift, the value of the books alone being estimated at over £1,200.

Even a bald account of the services rendered by Sir Joseph to the Royal Society may seem to a reader unacquainted with its history to be unduly exaggerated. One, however, can truly assert that his influence, generosity, and powers of administration raised it from an obscure position to be among the most influential scientific bodies in the Commonwealth. He was elected a Fellow in 1878 when it was designated the Adelaide Philosophical Society, and at the time of his death, on July 29, 1933, was the doyen of the Society. In 1903, when he was first elected President, its fortunes soon brightened. He was elected President year by year until 1921, when he declined further nomination; but the Fellows were determined to keep him on the Council and during 1921-23 elected him one of the Vice-Presidents, and until the day of his death he remained a member of the Council. In the year Sir Joseph Verco became President our Royal Society was incorporated, thereby possessing the legal privilege of owning property and of being able to sue as well as of being sued in a court of law. One result of this was that the Society began building up a Research and Endowment Fund. Sir Joseph started it in 1908 by contributing £1,000, and the other principal donors, Mr. Thos. Scarfe (£1,000), Mr. R. Barr Smith (£1,005), Sir Edwin Smith (£200), and Mrs. Ellen Peterswald (£100), were each persuaded by Sir Joseph to bequeath their respective contributions to this valuable fund that for ages should radiate its beneficent energy in aid of scientific research in South Australia. Nor did the contribution to the Endowment Fund exhaust the financial aid that Sir Joseph gave: at one time the Society was confronted with the difficulty of properly displaying the large number of exchange publications that yearly poured into it, and, to provide extra shelving to display them, Sir Joseph's cheque came as a great aid; he presented also the handsome Presidential chair. Those who recall the methodical habits and great care that characterised Sir Joseph in all his work need not be reminded that his duties as President were ably carried out: he listened attentively to all papers and his comments on them were shrewd and kindly; his own papers on conchology were models of compression and clear in style; his rulings from the chair showed a knowledge of the Rules and Regulations laid down by the Society; and the influential position he had attained in South Australia was a powerful factor in successfully urging the claims of science to the consideration of its citizens.

Since his death it has been known that his benefactions to the Royal Society have not ended. His will, for which probate was recently granted, showed that he was a wealthy man. The income from the estate has been bequeathed to Lady Verco for life, and we all earnestly hope that she may long enjoy it; but when the

inevitable happens, the whole estate is to be divided among many philanthropic, religious, and scientific bodies, among the last-named being the Royal Society. This bequest should substantially increase its Endowment Fund.

The Society has not been ungrateful to the memory of its greatest President. In 1928 it established the Sir Joseph Verco Medal, to be awarded for distinguished scientific investigations carried out by a member of the Royal Society of South Australia. The first recipient of the medal was Professor Howchin, who has won a distinguished name for the work he has done in proving the wide extent of glacial action in Australia. Sir Joseph attended the presentation ceremony and handed the medal to Prof. Howchin. It was Sir Joseph's last recorded attendance at the meeting of a Society on which, for a half century, he had lavished much devoted attention.

ADDENDA.—The "South Australian Naturalist" for August, 1933, contains the titles and references to all the malacological papers published by Sir Joseph Verco between the years 1895 and 1931. There are 26 papers recorded, the last two being in conjunction with Mr. Bernard C. Cotton, of the S.A. Museum.

The following list, kindly compiled by Prof. J. B. Cleland, M.D., gives the names of species of animals named in honour of Sir Joseph Verco by different naturalists, as well as a reference to the periodicals in which they first recorded them:—

I. MOLLUSCA.—(GASTEROPODA) *Notocypraea verconis* Cotton and Godfrey, 1932, a cowry for S.A., W.A., and Tasmania (1, xiii., p. 41); *Prosimnia verconis* Cotton and Godfrey, 1932, S.A. (1, xiii., p. 46); *Nassarius verconis* Cotton and Godfrey, 1932, Verco's *Nassa*, S.A. (1, xiii., p. 95); *Alcithoe verconis* (Tate 1892 as *Voluta)*, S.A. (3, xv., p. 125, fig. 5); *Aethodoris (Albania) verconis* Basedow and Hedley, 1905 (3, xxix., p. 154); *Nembrotha verconis* Basedow and Hedley, 1905 (3, xxix., p. 158). (PELECYPODA) *Protonucula verconis* B. C. Cotton, 1930. Dredged by Sir Joseph at Eucla (2, iv., p. 223); *Scaeoleda verconis* Tate (as *Leda)*, 1891 (3, xiv., p. 264); *Corbula verconis* Finlay, 1927 (4, 57, p. 531). (POLYPLACOPHORA) *(Loricata) Ischnochiton verconis* Torr, 1911 (3, xxv. p. 102) = *Strigichiton verconis; Chiton verconis* Torr and Ashby, 1898 (3, xxii., pp. 215-216); *Acanthochiton verconis* Torr and Ashby, 1895 (3, xxii., pp. 217, 218).

II. CRUSTACEA.—*Leptostylis vercoi* Hale, 1928 (3, lii., p. 48). A Cumaceous Crustacean of Geographe Bay, W.A.

III. PISCES.—*Syngnathus vercoi* Waite and Hale, 1921 (2, i., p. 298). A Lophobranchiate fish dredged in St. Vincent Gulf by Sir Joseph.

REFERENCES:—1. S.A. Naturalist; 2. Records of S.A. Museum; 3. Trans. Roy. Soc. S.A.; 4. Trans. N.Z. Inst.

B. S. R.

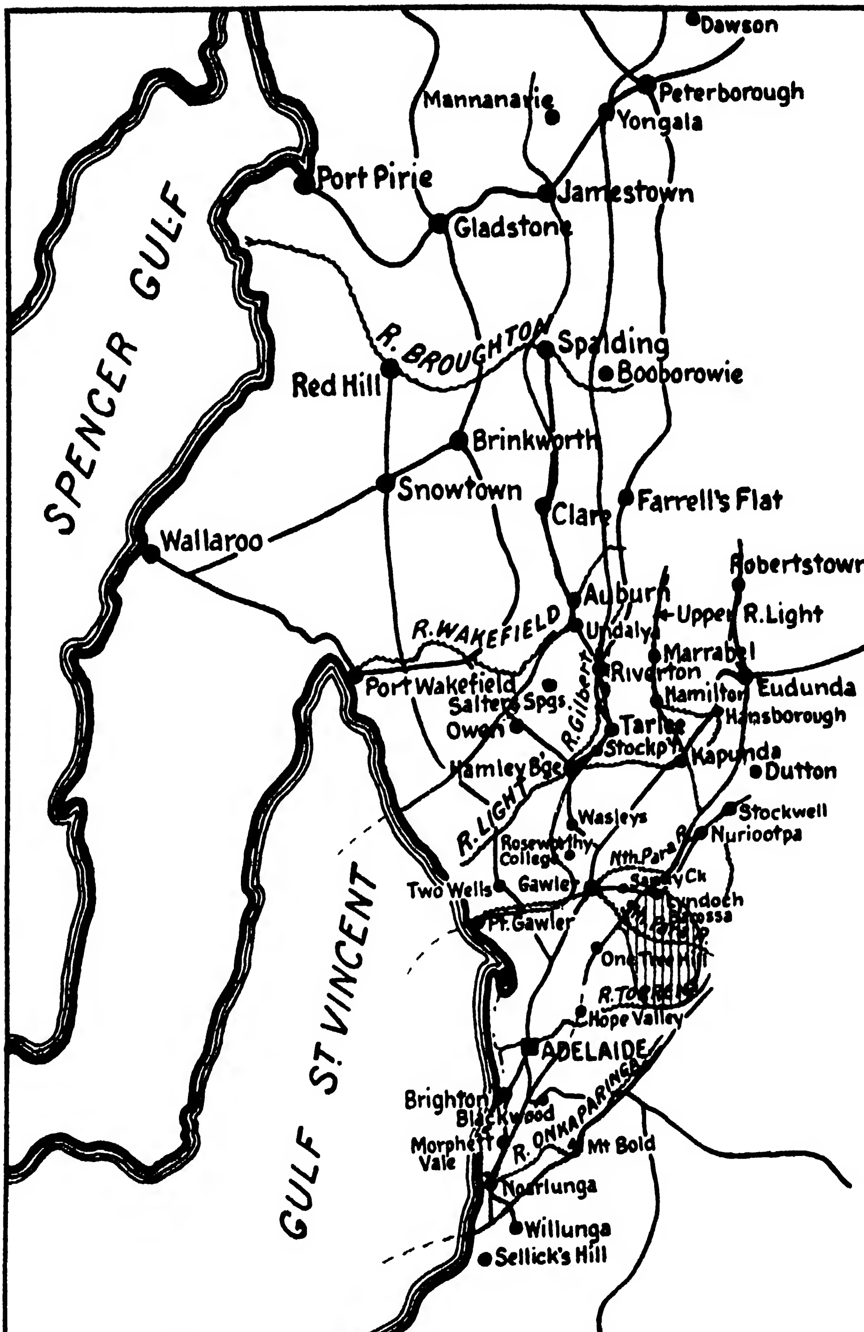

Fig. 1. Map of part of South Australia on which is shown, in red, the probable direction of some of the main river courses [the eastern group] before they were truncated.

Transactions

of

The Royal Society of South Australia (Incorporated)

VOL. LVII.

THE DEAD RIVERS OF SOUTH AUSTRALIA.

PART II.—THE EASTERN GROUP.

By Professor Walter Howchin, F.G.S.

[Read November 10, 1932.]

Plates I. to IV.

Contents.

In a previous paper [Trans. Roy. Soc. S. Austr., vol. lv., 1931, p. 113] it was explained that the original river systems of South Australia followed an inclined plane from Central Australia to the southern coast. The elevation of the Mount Lofty Ranges, at a comparatively late geological period, formed an east-west barrier to the central drainage by which these older rivers were truncated and formed numerous lakes on the northern side of the barrier. Although the rivers ceased to flow in their lower channels the physical features incidental to their former existence have persisted, somewhat modified, to the present time. Among these features the most remarkable are the extensive deposits of sands and gravels, in a consolidated (as well as unconsolidated) condition, which bear testimony to their former existence.

In the former paper, referred to above, the western occurrences of these extinct rivers were approximately defined as to their respective origins and the channels that they occupied. The most easterly member of this group was the river that had its source to the northward of Lake Frome and followed a southerly course by the way of Orroroo, Caltowie, Gulnare, and Rochester, finally uniting with another trunk river that formerly came down the Koolunga and Snowtown plain. Our present purpose is to follow up these investigations with respect to those extinct rivers that formerly drained the eastern portions of the Mount Lofty Ranges and had their outlet via the plain that is now drowned by the sea in Gulf St. Vincent. [See fig. 1.]

I. MANNANARIE, JAMESTOWN, SPALDING, CLARE, AND WAKEFIELD VALLEY CHANNEL.

(1) Mannanarie and Jamestown.

The township of Mannanarie, in the Hundred of the same name, is situated on a plain, four miles to five miles in width, with a northerly extension which connects it with the Black Rock Plain. The same valley extends, meridionally, in a southerly direction for about 70 miles. It is bounded on the westward, by the Mount Lock, the Bundaleer, and other ranges; and, on the eastern side, by the Browne's Hill Range, the Belalie Range, Camel's Hump, and other ranges, forming, respectively, the eastern and western boundaries of eight Hundreds in lineal succession.

In the neighbourhood of Mannanarie township, a flat, low median ridge divides the plain, longitudinally, into two parts, giving rise to two parallel, subordinate valleys, that follow the base of the ranges on either side to beyond Jamestown. By following the plateau (or middle road) from Jamestown, southwards, the valleys on the right and left are well seen. Eight miles from Jamestown the road, going south, comes to a dead end, facing Section 7 [Hd. Belalie], with steep roads going right and left down to the respective secondary valleys. These, originally, were united and formed a single main river channel. In the border districts of the Hundreds of Belalie and Reynolds a low, flat water-parting crosses the valley in an east and west direction, but the ancient valley passes over this slight rise and is continued to Clare, via Spalding.

The last-named township is situated near to the River Broughton, which occupies the lowest position in a broad and shallow trough that forms a peculiar physiographical feature in the district, and needs explanation before proceeding further with the subject of the extinct river.

(2) The River Broughton Depression.

In the elevation of the Mount Lofty Ranges minor secondary movements of both elevation and depression took place which had important effects on the drainage. In the case now under consideration the ancient river channel under-

went a transverse down-fold, or sag, having a north and south length of 45 miles. Jamestown, on the northern side, has an elevation of 1,495 feet above sea level; and Clare, on the southern side, an elevation of 1,305 feet; while Spalding, near the axis of the down-fold, has a height of only 945 feet, showing a depression between these marginal points of about 400 feet.

The River Broughton was brought into existence to carry off the drainage that became concentrated as a consequence of the sagging of the contours. The stratigraphical features are not affected by this depression, and the streams of the main valley have preserved their meridional courses—only, whilst those on the northern side have retained their southerly direction, those on the southern side have become reversed in their flow, as determined by the altered direction of the grade.

The River Broughton is the most typically defined as a transverse river in the existing river systems of South Australia. It takes its rise on the Booborowie plain, fed by numerous streams from the western flanks of the Bald Hill Range, where it is known as the Yakkalo Creek. After crossing the Booborowie plain, at right angles, it cuts through the Camel's Hump Range, crosses the Spalding plain, and, near the latter township, intersects the Bundaleer Range, where it has entrenched itself in the strong rocks of the Adelaide Series, excavating a deep and rough gorge that is continued to Yacka; which, in a straight line, would represent 12 miles, but is probably twice that distance in following the tortuous course of the river. It is, emphatically, a superimposed river discordantly developed on an older system that has become defunct, cutting transversely through four of these primordial channels in its passage to the sea.

(3) Spalding and Neighbourhood.

The township of Spalding, situated near the northern banks of the River Broughton, together with the Freshwater and Deep Creeks, draining in from the north, and the Hutt and Hill Rivers draining in from the south, show associated features that may be considered together as a geographical unit.

The width of the valley, from ridge to ridge, varies from about eight to nine miles, while the valley proper has an average width of four miles. As a general feature, the central portion of the valley, longitudinally, from north of Jamestown to Clare, has the form of a low plateau, two to three miles wide, bordered on either side by longitudinal streams, as, for example, the Hutt and Hill Rivers. This central, meridional plateau is sculptured into rounded, oblong hills, mostly flat-topped, which represent the original peneplained valley floors, which often carries consolidated river material. The bed-rock of the district consists entirely of the upper members of the Adelaide Series, beginning with the Glen Osmond Slates and Quartzites; and, rising, include the Sturtian Tillite, Tapley's Hill Slates, Brighton Limestones, and, at Clare, the Purple Slates of the Cambrian Series. The strike is approximately north and south, and at, or near, the vertical in dip. The Sturtian Tillite, which has been subjected to much denudation, and occurs mostly level with the general surface, is exposed on the western side of Yongala, and passes southward close to Spalding, following the main platform between the Hutt and Hill Rivers, southward to the eastern side of Clare. A very extensive exposure of the tillite can be seen in the bed of the River Broughton, at the swimming pool, near Spalding. Slates are the dominant feature of the district and form most of the high ground, where they are but little decomposed, but are uniformly rotten and decomposed where the ancient alluvial rests upon them. [See also forward, at page 13.]

(4) Freshwater and Deep Creeks.

Freshwater Creek has its origin in the slight rise that forms the border lands of the Hundreds of Belalie and Reynolds, and is fed by a series of flood waters that are delivered from the western flanks of the eastern ranges. The banks of

the stream are usually about 15 feet in height and consist of alluvium. Where the bed-rock is exposed, which is rarely the case, it consists of slate in a kaolinized condition. There is little lateral erosion, but, at one spot, where the road approaches the banks of the stream, lateral washouts have cut into the banks and reduced the land, for an acre or more, into the condition of "bad-lands." The water in the channel is derived mostly from soakages from the sides, is of small quantity and intermittent in occurrence. The stream, after flowing for 18 miles in a north-south direction, junctions with the River Broughton at the Recreation Reserve, Spalding.

Deep Creek is situated nearer to the eastern ranges than the Freshwater Creek and has a direct drainage from the ranges, which gives a more effective erosive force to the stream. It is the deepest of the local streams and, in one part of its course, shows a sheer wall of sediment 60 feet in height. Nearer to its junction with The Broughton it is contracted and relatively small, having, by the absorption of its waters in the alluvium, on which it chiefly rests, lost much of its energy. It has a length of about six miles.

Very thick alluvial sediments occur throughout the district now under description. Alluvial ridges fill the space between the Freshwater Creek and Deep Creek. Mr. Michel sank a well in Section 391 [Hd. Andrews], near the boundary dividing the latter Hundred from the Hundred of Reynolds, to a depth of 150 feet in river deposits. A well sunk near the Masonic Hall, in Spalding, was in river sand to 28 feet, when it had to be discontinued on account of the running sand and water. The same result followed in another well situated at a short distance from the latter.

A deposit of sand in an old valley, between two ridges of Tapley's Hill shales, supplied the sand required for making the cement in the construction of the open culvert of the Bundaleer Reservoir. The deposit is at high level, above the caretaker's house, in Section 382 [Hd. Andrews], four miles to the south-eastward of Spalding, not far from "Marble Hill."

Consolidated Alluvia near Spalding.

In this district, as elsewhere, there are many examples in which the ancient alluvial deposits have been very strongly consolidated, both by silica and hydrated iron-peroxide. The silica, in the form of chalcedony, has frequently penetrated the fine argillaceous and sandy material, converting the sediments into an intensely hard and tough rock, and the coarser gravels into massive conglomerates, often of considerable thickness. The infiltration is sometimes irregular, forming concretionery and stalagtitic masses. The following local occurrences may be mentioned:—[1]

(a) In Section 88 [Hd. Reynolds], two miles northward of Spalding, situated on the northern side of the east-west road and adjoining the main road between Spalding and Jamestown, are several patches of consolidated alluvium. One of these, visible from the road, covers an area 80 square yards, and at a distance of about 100 yards further to the northward, a similar exposure occurs of about the same size. The two patches are on the same level and were originally united. Some distance to the westward of these, but in the same Section, is a much larger patch, also having a north and south direction, extending for about 140 yards. The remains, which originally consisted of clay and sand, are now strongly cemented and, where exposed, exfoliate in large spherical or irregular masses.

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[1] I am much indebted to the Rev. B. S. Howland, of Spalding, for valuable assistance in exploring this locality. His intimate knowledge of the country and interest in the subject led him, not only to render willing service, but was also successful in making independent observations on the occurrence of certain consolidated gravels in the neighbourhood of Yongala, Spalding, and Booborowie, which have since been visited and corroborated by the writer.

(b) Going southward, Hundred of Andrews, Section 393, situated on the eastern side of the main road, one mile northward of Spalding, three more exposures follow a north and south line. The smallest group, covering about six square yards, occurs near the northern limits of the Section; the second is about a chain square; and the third covers a much larger area; in each case the stone is fine-grained and very siliceous.

(c) Within the limits of the township of Spalding, behind the public school, lumps of conglomerate occur scattered over the surface.

(d) Following the cemetery road, in a south-easterly direction, about a mile from Spalding, on the eastern side of Section 398, a ridge occurs, the top of which is capped by consolidated gravels that extend in a north and south direction for one-third of a mile, the cement being of a ferro-siliceous nature. On the opposite side of the road from the latter, in Section 373, on a similar elevation, are two other patches of a like kind.

(e) In Section 398, on the southern side of the Bundaleer reservoir channel, on the property of Mr. F. Trengove, is a remarkable vertical monolith of siliceous ironstone, which, from the road, has the appearance of an ancient haystack. It stands about 9 feet high and is in contact with a ferruginous quartz conglomerate. This prominent feature is in the direct line of the ancient gravels, while the connecting spaces between the rocks, *in situ,* are scattered with blocks and individual boulders of the same description.

(f) In a direct line with the preceding, after an interval of low ground, the deposits follow the top of a ridge, going southwards, through Sections 345, 290, 287, and 286, in a length of one mile, extensive slabs of the consolidated alluvia occur at about surface level, while innumerable water-worn quartz pebbles, liberated from the old alluvial deposits, are scattered over the paddocks.

(g) On a more westerly line, in Section 3528, southwards of the Spalding Recreation Reserve, a small outcrop of the conglomerate occurs, and continues southward in occasional exposures through Sections 342 and 341; also, on the opposite (western) side of the main road to Clare, in Section 407.

(5) Hutt and Hill Rivers.

These rivers take their rise in the knot of hills that surround Clare, Seven Hills and Penwortham, of which Mount Oakden and Mount Horrocks are the chief heights. They follow a parallel course throughout their respective lengths, separated by about two miles of a broken plateau, as already described. They follow a low, downward grade, from Clare, northwards, to The Broughton, near Spalding.

Like the streams situated to the north of Spalding, those on the southward side occupy the bed of an ancient river, the main physical features of which they have had no part in developing, but, like The Broughton, they are superimposed on an older system and, in the case of the Hutt and Hill Rivers, actually follow a reversed direction from that which the older river followed.

The Hutt River drains the western portions of the main valley, fed from the higher ground on either side. It is less tortuous than the Hill River, but has precisely the same general characteristics. It flows (when it carries sufficient water to reach its outlet) into the River Broughton, at the western angle of the great northern bend of the latter, shortly before The Broughton enters its rocky gorge. The Hutt River makes a very insignificant junction with the main stream by what is little more than a narrow gutter over which a man could easily straddle.

The Hill River is of little more importance than the Hutt River. It is indeed a gross exaggeration to call either stream a "river." The Hill River is seldom wider than can be stepped or jumped over, and might be more appropriately called a "ditch." It follows a most serpentine course, the banks are only a few feet in

height, vertical, and consist of alluvia. The grade is low—not more than 15 inches in the mile—and the current feeble. It seldom, if ever, rises above its banks. and the weakness of its flow is seen in that, notwithstanding the sharp angles it makes, fails to undermine the banks at their acute curves. The bed is mostly dry, except at intervals where pools of water remain, probably held up by the presence of clay deposits, or older rocks either at, or near, the surface. The bed of the stream is mostly choked by a growth of reeds. It unites with The Broughton, near to that of the Deep Creek affluent, which comes in from the opposite side, and is about two miles to the south-eastward of Spalding. The junction is made by a narrow drain, while most of the water that comes down at flood times spreads out over the surrounding land, forming, for the time being, a swamp. Its length, in a direct line, is about 30 miles. It is narrower at its outlet than it is at its source.

Consolidated Alluvia between Spalding and Clare.

(a) About five miles more to the southward than the last-mentioned occurrence [see p. 5 *(g)*] and nearly opposite to the township of Euromina, on its eastern side, heaps of a ferruginous, coarse conglomerate were observed at the side of the main road, that were being broken for road metal. A local resident stated that these stones came from the higher ground on the eastern side of the Hill River valley.

(b) The most remarkable occurrence of these ancient alluvial remains that came under the writer's notice in the Hutt River and the Hill River district was in Section 571, Hundred of Milne [pl. I., figs. 1 and 2]. It is situated on the western side of the "middle road" (between the two rivers mentioned), which here runs parallel with the White Hut Creek, a tributary of the Hutt River and about a mile to the westward of Hilltown. The eastern scarp of the formation can be well seen from the road at an elevation of about 80 feet above the latter. The rock is a coarse conglomerate carrying white water-worn pebbles of quartz, up to six inches in diameter, very strongly cemented. The bed forms the capping of a flat-topped hill, which, by measurement, proved to be four acres in extent, with an apparent original thickness of about 15 feet.

(6) Clare.

In the neighbourhood of Clare and Seven Hills there is a knot of hills that intercepts the ancient waterway and forms a local water-parting. The Clare railway station is 360 feet higher than the railway station at Spalding. The physiographical history of this group of hills is obscure. The geological features agree with those that are present both north and south of this area. It is possible that in the epeirogenic elevation of South Australia some differential movements of elevation and depression took place which established local watersheds and which, under fluvial erosion would become intensified. This seems to have been the case in the reversals of the streams in the Hill River valley.

On the eastern side of Clare, the Hill River occupies a wide valley, choked with silt and is subject to overflows. The river takes its rise on the northern slopes of Mount Horrocks, and the River Wakefield, flowing southwards, takes its rise immediately to the eastward of the latter.

(7) River Wakefield Valley.

The water-parting on which the River Wakefield takes its rise, at 1.000 feet above sea level, carries alluvial sediments in a thickness that could scarcely be expected in such a position. Near Undalya the river has cut its bed in these sediments, which, on its left bank, show vertical cliffs 30 feet in height. After leaving Undalya, the river swings round to the westward and cuts into the high ground on its right bank, and apparently follows the western side of the original river channel.

Like most of the superimposed rivers of recent date, in its lower reaches it takes on a westerly course, transversely to the ranges, cutting a gorge in the older rocks, until, within about seven miles from Balaklava, it leaves the latter and enters on the great Snowtown plain which formerly carried the important trunk line of drainage that came down from the north via Crystal Brook, Koolunga, Snowtown, etc. At Whitwarta, near the apex of the northern bend of the river below Balaklava, the newer alluvial deposits are seen to rest on an older bed of compact, mottled clays, that are characteristic of the antecedent river deposits.

Consolidated Alluvia in the Wakefield Valley District.

From Undalya, the ancient valley is bounded on the westward by the Wakefield Scrub Range, and on the eastward by the Alma and Rhynie Ranges. At several points within this area consolidated fine material and siliceous conglomerates were observed.

(a) Exposures on the ridge that forms the high ground on the western side of the River Wakefield occur on Mr. R. H. Dennison's property. [Private House on Sec. 98, Hd. of Up. Wakefield.] Shortly after entering the gate on the private road to the house, in Section 86, several exposures of a compact, ferruginous conglomerate were seen on the high side of the road and level with the surface. Also on the rise of the hill fragments of the conglomerate, as well as white quartz pebbles, weathered from the latter, are scattered over the ploughed land. These deposits are about a quarter of a mile back from the river and about 100 feet above the level of the latter.

(b) At Salter's Springs, Hundred of Alma [about nine miles south-westward of Riverton], two outcrops occur in a lineal order. The first of these occurs on the north-western road, at about three-quarters of a mile from the Salter's Springs village, before reaching the six-road ends. A large mass of a ferruginous conglomerate lies by the road (on its eastern side), and in the paddocks, on either side [Sections 37 and 50], there are scattered fragments of a similar conglomerate and well-rounded quartz pebbles, one of those obtained had a circumference of 13 inches. The other deposit is situated a little over two miles from Salter's Springs, in the same direction as the preceding, on Section 14. The larger stones have been dragged to the north-eastern angle of the Section and form two heaps, of about a dozen stones each, in a slight depression in one of the head waters of the Hermitage Creek. The stone is a highly siliceous and glassy conglomerate. The white quartz pebbles make a striking feature, set in the glassy matrix, when seen in section. These two occurrences near Salter's Springs are not conspicuous and might have been missed but for the kind assistance of Mr. Robert Smyth in guiding me to the localities.

From Salter's Springs the ancient river-course continued in a south-westerly direction (to the westward of Balaklava), via Owen and Stockyard Creek, where it united with other lines of drainage in the sandy plains bordering on the St. Vincent region.

II. DAWSON, PETERBOROUGH, YONGALA, BOOBOROWIE, RIVERTON, STOCKPORT, WASLEYS, AND TWO WELLS CHANNEL.

(1) Peterborough and the North-eastern Plain.

An extensive plain extends from Peterborough in a north-easterly direction for 40 miles, passing through the Hundreds of Coglin, Cavenagh, and Minburra, having a drainage in a southerly direction. At 50 miles northward from Peterborough the drainage is reversed and flows towards Lake Frome.

This important north-easterly plain runs, approximately, parallel with the Orroroo plain from which it is separated, going northward, by the Peterborough

Range (in which the Sturtian Tillite is a marked geological feature), Black Rock Range, Peaked Hill Range, Eke's Hill, Marchant's Hill, etc. Dawson is on this plain, 15 miles northward from Peterborough.

Peterborough is unfortunately situated. The alluvial soil, on the north-eastern plain, is absorbent of the ordinary rainfall which drains from the higher ground, but with heavy rains the valley carries flood-waters that impinge on the township, to divert which a definite channel has been cut to carry off the drainage. From Peterborough the flood-waters take a south-westerly direction, passing to the northward of Yongala (which is 56 feet lower than Peterborough), and blend with the Nalia and Boniah Creeks, which have a northerly trend and are lost on the Black Rock Plain.

(2) Yongala and Canowie Belt.

(Near the Crest of the East-west Water-parting.)

Judging from the numerous deposits of the consolidated alluvium, in the neighbourhood, Yongala was in the direct line of the old river channel.

(a) The most northerly deposit of this kind, seen, was in Section 179 [Hd. Yongala], a little more than two miles north-easterly from Yongala, on the western side of the main road to Peterborough. It can be recognised as an unploughed patch, about 125 yards in from the road. The deposit covers 6 yards by 6 yards, with large blocks resting on a floor of similar material. The stone is a silicified sand-rock, the upper surface sometimes showing nodular prominences. Large stones of the same kind occur beside the road.

(b) In Section 175 (towards its northern boundary), about half a mile south-easterly from the last-named occurrence, a similar group can be seen from the road. The stone is light-grey and buff in colour, and, by means of a hand-glass, is seen to be a fine, silicified silt, containing well-rounded sand grains. Surface smooth.

(c) In the same Section, situated at its south-western corner, between the main road and the railway, one mile from Yongala, is a conspicuous deposit of large blocks that form the side of a small dam, just inside the fence and for some distance around, crossing the railway, and also in lumps along the road. It consists of fine-grained, silicified material, sometimes showing mammillary surface features.

(d) One mile east from Yongala, on the southern side of the public road, level with the surface, is a small exposure of a nearly pure form of a yellowish chalcedony, showing red lines, and spotted with small granules of red oxide of iron, each surrounded with a white aureola. Also at the same spot, on the northern side of the fence, in Section 174, is a coarser siliceous rock, very dense, in which sand grains are visible by means of a hand-glass; occasional cavities occur in the rock.

(e) In Section 19, one and a half miles south-westerly of Yongala, there is a very extensive and remarkable exposure of this class of rock. It covers the upper portion of a flat-topped ridge, either above or slightly below the surface, estimated by the owner to have an area of from seven to eight acres. It also extends into Section 22, near the fence. At the southern end it forms a compact, solid wall of rock, six feet high, with a breadth of 10 yards and a length of 90 yards. It consists mainly of a white-quartz conglomerate.

(f) At a distance of half a mile, in a north-westerly direction from the last-named, in Sections 159 and 161 [Hd. Mannanarie], there is a still larger exposure of the older alluvia. It crosses the road to Yongala, and at its northerly limits shows an elevated peak-like scarp. The stone generally is a brownish and coarse-grained sand-rock, cemented, but not quite so highly silicified as is commonly the case, except at its northerly extremity. Towards its western margin it is conglomeratic.

To the southward of the township of Yongala there are almost continuous exposures of these rocks for a distance of 10 miles, as far as Canowie Belt.

(g) Section 111, one mile from Yongala, near mile post, a few yards inside the fence, there is a patch of the fine-grained siliceous type, 5 yards by 10 yards in extent. At a quarter of a mile further, southward, is another similar exposure.

(h) Section 16, two and a quarter miles from Yongala, exposures occur in the field, on the western side of the road. Two large patches, situated approximately 350 yards in from the road, level with the surface and also in large blocks, extending over 23 yards by 13 yards. The stone is a white-quartz conglomerate —pebbles up to six inches in diameter.

(i) In the next field, 300 yards to the southward of the preceding, a similar conglomerate covers an area a chain square. Also to the south-east of same, situated in the corner of Section 15, at the three mile post, close to the district road, going west.

(j) On Travelling Stock road, opposite Section 96, there is a white silicified sandstone, consisting of four large blocks, and others, extending southwards.

(k) Section 180 [Hd. Whyte], and on by-road forming the southern boundary of the Section, situated a half-mile eastward of the main road, before reaching bend in the road, a fine-grained, light-coloured, silicified argillaceous sand, with water-worn grains, that covers 64 yards by 300 yards, much of it in large slabs, level with the surface. Also extends southwards from the road, in Section 179, and, as seen from a distance, still further south, forming crest of hill.

(l) Eight miles from Yongala, seen on district road, between Sections 164 and 490, and on each of these Sections, in eight large patches, covering many acres. The stone is very siliceous and compact, cementing fine sand mixed with some larger grains. Surface sometimes smooth and mammillary.

(m) About nine miles from Yongala, on the eastern side of the road, near the centre of Section 491, about 400 yards in from the main road (is best approached from the east by back road), a most extensive area of consolidated alluvia, forming raised terraces covering several acres. On the southern side the material consists of fine particles, cemented by silica; including two peculiar smooth-surfaced pyramids that stand up about 6 feet from the general level, having a circumference, at the base, of about 10 yards. The northern side of the deposit is a coarse conglomerate consisting of white-quartz pebbles.

(3) Booborowie South.

The ancient Yongala-Canowie valley continues well defined in a north and south direction through the Hundreds of Whyte, Anne, Ayers, Hanson, Stanley, Saddleworth, and Gilbert, to the township of Riverton, and there becomes the valley of the River Gilbert. Within these Hundreds the valley is bordered by the Mount Bryan and Bald Hill Ranges, on its eastern side; and by the Belalie, Mount Browne, and Camel's Hump Ranges on its western side.

At Booborowie South some extensive deposits of consolidated alluvia occur, as follow:—

(a) The public road that goes eastward from the Andrews railway station passes from the Hundred of Andrews into the Hundred of Ayers, between Sections 374 and 379 of the latter Hundred. After passing the first cross road, the latter takes a rise and the old conglomerate is exposed at surface on the road and continues for about a quarter of a mile, forming the lower platform of the alluvial beds. A second rise on the road forms the crest of the minor ridge [Section 90]. On this ridge, and on the slope, on the other side, there is a very extensive show of the fine-grained siliceous alluvium. In making the road over the crest the deposit had to be quarried, and the stones were left by the side of the

road in large lumps. The area covered by the beds at this spot, on the road and over the fences on either side, was proved to be 174 yards, in an east and west direction, and 43 yards, north and south.

(b) In the paddock, to the southward of the main exposures on the road, at a distance of 200 yards from the latter, large blocks of a quartz-pebble conglomerate, resting on a floor of the same material, form a patch that measures 10 yards by 6 yards.

(c) In the paddock, on the opposite side of the same road (on Mr. E. W. Hawker's property), both fine and coarse masses of consolidated alluvia occur. Also, in the same Section, about 400 yards to the eastward of the last mentioned, is another patch.

(d) Subsequently to the above observations, Rev. B. S. Howland reported the existence of another exposure, situated on the same road, about a mile further to the eastward of those just described, bordered by Section 81, and at about the same level as the preceding.

(e) Near a main road, about a mile northward of the last described, and parallel with it, there is a patch of conglomerate a few yards wide and level with the ground. It is situated to the westward of the Booborowie Creek, shortly before the latter crosses the road [Section 366], and about 240 yards to the eastward of the house on Mr. Hawker's property.

(4) Riverton and Tarlee

South of Booborowie the valley follows a south-south-east direction and is drained, throughout the whole of the Hundred of Hanson, by Farrell's Creek. The creek has a north and south course and is, in part, at a local base-level. The drainage is defective and, in winter, swamps and temporary lakes are developed. On the eastern side of both Farrell's Flat and Merildin (Mintaro) railway stations there are well-defined salt lagoon areas. In the adjoining Hundreds of Saddleworth and Gilbert, the River Gilbert carries the drainage and continues southwards to Hamley Bridge where it discharges into the River Light.

Riverton is situated on the River Gilbert, in the Hundred of that name. The following observations were made in 1911. A few stones of the older alluvium were noticed on a rise, on ploughed land, a little to the north-eastward of Mr. W. S. Kelly's homestead at Giles' Corner. Also on the public road, a short distance to the eastward of Riverton, a few similar stones had been utilized, with some others, to stop a small washout beside the road. In neither case was the formation seen *in situ*.

Tarlee. Observations made in 1921. Remains of ancient river terraces occur on the slopes of the valley, on the eastern side of the township, the deposits being more or less indurated.

(a) At one and a half miles to the north-eastward of Tarlee, in Sections 1931 and 357 [Hd. Gilbert], near the cemetery.

(b) A low ridge, having a surface of ferruginous sands and gravels, crosses the east-west district road, in Sections 275 and 326 and is also seen in a small excavation by the side of the road that divides these Sections, three feet deep without reaching the base.

(c) The following examples also occur in this neighbourhood. A little more than a mile to the southward of Tarlee, on the east-west road that forms the southern boundary of the Hundred of Gilbert, in Section 322 (adjoining the railway), there are surface stones of the usual consolidated type, as well as a heap of the same kind near the fence; the rock is also seen, *in situ,* in an excavation in the same paddocks.

The late Mr. J. J. East (1, p. 3), in a Geological Section of the country now under description, shows a Tertiary formation of a "gritty sandstone" resting

unconformably on the older rocks of the chief ranges of hills. He states: "The most extensive and unbroken series of it is met with on the Alma Range, where it forms a cap and flanking formation all the way from Stockport to Saddleworth." I cannot confirm his determinations in this respect. He has evidently mistaken a light-coloured quartzite, of the Adelaide Series, which is sometimes partially decomposed, for a Tertiary rock. The "blue-clay," which he also associates with his Tertiary beds and correlates it with the blue clays of the Adelaide Plains, is evidently the decomposed condition of the blue-metal limestone and shale of the Adelaide Series. He recognised the existence of the ferruginous conglomerates of the district, that occur at a lower level, but did not realize their significance.

(5) STOCKPORT, RIVER LIGHT, HAMLEY BRIDGE, AND WASLEYS.

(a) Stockport is the centre of one of the most extensive deposits of the ancient alluvia within the State. The River Gilbert, an insignificant stream, has cut its way through these deposits to a considerable depth. As the train, going north, nears the railway station, these beds form scarps on both sides. On the western side, a horizontal terrace forms the sky line, rising from the water level to a height of 60 feet. The scarp face on this side is composed of very strongly cemented ferruginous sands and gravels that are exposed in a quarry face where the stone is broken for road metal [pl. II., fig. 1]. The surface of the terrace carries, in places, sufficient light, sandy soil to admit of cultivation, but a large proportion shows a rocky surface that cannot be ploughed. The ancient terrace goes westward for three-quarters of a mile and is surrounded by a district road [the southerly portion is now closed] that embraces Sections 121, 122, 601, 602, and 636 [Hd. Alma]. The south-westerly portions consist of a rocky floor with a massive scarp, facing west; the rock, on one side, consists of fine material, very strongly cemented by silica, and on the other, a coarse quartz conglomerate. These stony patches cover several acres. On the northern side, these deposits cross the road and are well developed in Sections 604 and 605. In the last named, a low rise is heavily covered with a very dense, siliceous, light-coloured example, that is deceptively like our most siliceous ancient rocks.

(b) Along the southern boundary of the ancient river terrace, just described, the River Gilbert has cut a wide channel in these beds, showing a scarp of the consolidated alluvia on its southern banks, which can be traced westwards for more than a mile.

(c) On the eastern side of Stockport the conglomerate deposits attain a high level. Following the main, easterly road from Stockport, the public school on the rise of the hill joins on to Section 484 [Hd. Light]. Here the ground is strewn with alluvium in both free and consolidated conditions. Two river terraces are indicated on this side, with large blocks of conglomerate on each. At a higher level, on Section 483 [Mr. Connelly's farm, in 1913], a remarkable deposit forms the hill top [pl. II., figs. 2 and 3]. The hill is conical in shape, coloured white round the collar and is capped by a layer of reddish conglomerate. The latter is about five feet in thickness and rests upon an uneven floor of white, kaolinized slate, forming part of the higher of the two terraces. This bed of ancient conglomerate is estimated to be situated 200 feet above the flat on which the township is built and above the base of corresponding beds on the opposite side of the River Gilbert. The hill, with its capping, can be seen from the railway, on the right hand, soon after the train has left the station, going north.

(d) The main road, going southward from Stockport, is bordered on either side by similar consolidated gravels, or sand. The writer followed a little used district road that runs eastward from the main road, southward of Stockport, to Light bridge, near Linwood, a distance of two miles. Blown sand, resting on harder reddish sand, continued as the surface feature all the way. Near Linwood, above the bridge, the river flows between banks of loamy clay, 20 feet in height.

A feature of these loamy banks is the presence of an enormous number of stalactitic concretions in the bed. These weather out of the cliffs and gather in such numbers at the base that they can be shovelled up in mass. In places, similar concretions occur as flat, irregular masses at certain horizons, like the rows of flint in chalk [Obs., in 1906]. The river has, here, probably intersected the remains of the older system of drainage coming in from the north, causing some rearrangement of the original sediments.

(e) Following the south road from Stockport, through sandy country for three miles, the road crosses the River Light at the new bridge (known as Ayliffe's bridge). The river has cut its way down through a great thickness of loamy clay, with steep banks, resting in places on rotten slates. On the southern side of the river, at a distance of half a mile, is a prominent hill in the form of a promontory, from which a good panoramic view of the valley is obtained. The hill has a height of about 170 feet above the river, consists, throughout, of alluvium, which, near the upper portion, contains a few large, but loose, masses of ferruginous conglomerate and a few scattered stones of silicified finer material. From the height referred to, an ancient, mature valley can be recognised, through which the River Light, as a juvenile, superimposed, and entrenched meander, has cut its course. On the northern side of the river, about a mile distant from the latter, is a ridge of white sand, carrying a scrubby vegetation, that is well seen from a distance and is estimated to be 200 feet above the river level.

(f) Within the river area, about a quarter of a mile below the bridge, the stream flows over a very strong bar of ferruginous conglomerate; and a little lower down (past the remains of an old bridge that was destroyed by a flood) vertical cliffs of clay form the banks. Above the new bridge ferruginous conglomerates occur both in the banks and in the bed of the river, at intervals, for a mile up stream. A little below the bridge, as well as a little above the latter, sections are seen in the clay cliffs that show two periods of deposition that are unconformable to each other, an older and a newer one. The clay banks bordering the stream have an average height of 20 feet.

The physiographical features of the country under description are of much interest. From Tarlee, southwards, and from Hamley Bridge to Stockport and Linwood (in an east and west direction, covering a distance of six miles), there are no prominent exposures of the Cambrian or Pre-Cambrian rocks, which suggest that a peneplanation had been reached in this district before the disruption of the older drainage; and also a base level that permitted the accumulation of alluvia in a thickness of at least 200 feet. The elevation of the ranges increased the grade, which rejuvenated the streams and gave birth to an east and west drainage that became centred in the River Light. The latter, through most of its course, has worked its way down through soft material, approximately, to the old base level, flowing occasionally over a shallow patch with small ripples, separated by long stretches of still water and large waterholes.

Hamley Bridge is situated three and a half miles, in a straight line, to the south-westward of Stockport. The main road between these townships passes through sandy country, and in a cutting on the road, adjoining Section 228, [Hd. Alma], a vertical face of fine gravel is exposed, five feet in thickness.

(a) A quarter of a mile northward of Hamley Bridge railway station, a shallow cutting occurs on the railway, consisting mainly of travertine limestone. A little further north a deeper cutting occurs, eight chains in length and about six feet in height, the chief feature of which is an indurated variegated sand-rock, partially silicified, interbedded with which is a thinnish bed of gravel, consisting of well-rounded quartz pebbles, reaching a diameter of three or four inches. The sand-rock is overlain by travertine limestone and, in one place, these ancient alluvial beds are seen to rest on white, rotten slates.

(b) At a short distance on the railway line, going southward, after passing over the River Light, another cutting occurs, 10 chains in length, with a maximum height of 12 feet, the greater part of which consists of indurated, mottled sand-rock similar to that, just described, on the northern side of Hamley Bridge. The highly kaolinized condition of the slates at Hamley Bridge is very characteristic of the ancient river channels.

(c) Two and a half miles further southward on the eastern side of the railway, at the south-western corner of a small plantation, in Section 251 [Hd. Mudla Wirra], are lumps of ferruginous alluvium, with fragments of a like kind scattered over the adjoining paddock.

The sandy country, mixed with clay, continues in a southerly direction as far as Gawler, including Wasleys. The outline of former sand-dunes in low ridges can be recognised. These are now protected from drifting through being covered by a mallee scrub, the whole district having been formerly covered by a scrub of this nature.

A bore was put down at Wasleys by the South Australian Government in 1886, particulars of which have been courteously supplied to the writer by officers of the Engineering and Water Supply Department, as follow:—

Depth from Surface in Feet	Thickness of bed, in Feet		Depth from Surface in Feet	Thickness of bed, in Feet	
3	3	Loam.	339	35	Hard grey rock.
27	24	Red clay.	360	21	Sandstone and quartzite.
33	6	Sandy clay.	377	17	Sandstone and quartz.
72	39	Red clay.	384	7	Hard grey quartzite.
116	44	Sandy clay.	453	69	Quartzite.
181	65	Yellow sand.	520	67	White quartzite with veins.
304	123	White sandstone.			Bore abandoned at 520 feet.

The Alluvial Series appears to end at the 304 feet level.

(6) Gawler, Roseworthy Agricultural College, and St. Kilda.

(a) Gawler shows a most striking section of these ancient alluvial beds. The town is built, partly, on the scarp face [Gawler East] of the most westerly step-fault of the ranges, and, partly, on the flat country at the base of the scarp. The fault to which the scarp owes its origin has truncated the old river bed, which is excellently exposed in vertical sections. On the southern side of the township the beds have been quarried by the side of the road and the material used for foot-paths, etc. The section shows alternating beds of sand, clay, and gravel. The sands are often consolidated into a toughish sand-rock, and the gravels consist almost entirely of white, well-rounded quartz pebbles, in various grades. Numerous specimens of silicified wood, showing organic structure, have been obtained from these beds. The edge of the scarp, at the summit of the road, is about 150 feet above the level of the plain, but it still rises at a lower angle to the eastward in cultivated ground. Mr. A. J. Sexton, manager of the local hydraulic works, gave me a nine-inch specimen of silicified wood that he had obtained, in a shallow sinking, about a hundred yards back from the edge of the scarp, showing an extension of the alluvial beds to the eastward.

(b) About a quarter of a mile to the northward from the quarries on the road mentioned above, is a much more important exposure of these beds in a blind, flattish gully (Martin's Gully) that, at some time, had been excavated by natural

means. As the sand from this locality had been extensively utilized for castings in the late James Martin & Co.'s foundry, the face has been worked in many places. The "gully" is about an eighth of a mile in length, in an easterly direction, and the alluvial face is about 50 feet in height, without showing bottom. The beds vary from a very fine white or yellowish sand, more or less indurated, up to a definitely silicified rock. Near the head of the gully is a strong exposure of this latter type, in which the rock has developed smooth and curved "jointing." Casts of stems and roots of trees are not uncommon in the beds. The ancient river channel, as exposed along the face of the scarp, has a length of nearly a quarter of a mile in a north and south direction.

The isolated nature of the Gawler deposits creates a difficulty in determining the topographical relationship which these bear to the obsolete river systems. Brown, in his Geological Map of the Barossa District (2), gives these an extension eastwards of two miles, separated by a gap of one mile from the Barossa beds of, presumably, the same age. On the other hand, they may have formed an easterly curve in the important river that at one time came down from the north, via Stockport and Wasleys, which seem the more probable explanation.

It is worth noting, in this connection, that there is a marked contrast between the water-worn pebbles brought down by the extinct Gawler River and those found today in the two Paras that flow on either side of it. In the latter case the rounded stones consist almost entirely of quartzite, with few quartz pebbles; while those of the ancient river are, with few exceptions of white quartz, which is a characteristic feature of the ancient trunk rivers that had a north and south direction. In an enquiry as to the nature of the deposits that lie to the westward of the gravels exposed on the Gawler East scarp-face, the following information has been obtained.

Many years ago a bore was put down in the Waterworks yard, near the base of the scarp, which proves the extension of the old river bed in a westerly direction. Samples obtained from this bore have been preserved in the office, and the local Manager, Mr. Sexton, courteously permitted the writer to examine the same and make the following record:—

Depth from Surface in Feet	Thickness of bed, in Feet		Depth from Surface in Feet	Thickness of bed, in Feet	
15	15	Surface loam.	85	5	White and yellow sand.
20	5	Brown sandy clay.	87	2	Coarse white pebbles.
26	6	Coarse sand.	93	6	Ferruginous grit.
33	7	Coarse gravel and sand.	101	8	Fine gravel, cemented.
40	7	Pipe clay with excessively fine sand.	104	3	White quartz pebbles.
			107	3	White clay and sand.
49	9	Sand and ferruginously cemented gravel.	110	3	Coarse, gritty sand.
			117	7	Darkish clay and grit.
53	4	White and yellowish sand.	130	13	Coarse quartz pebbles.
54	1	White quartz pebbles.	149	19	Very fine sand.
55	1	Consolidated white sand.	155	6	Argillaceous dark-coloured sand.
74	19	Argillaceous coarse sand.			
76	2	Sand and small pebbles.	156	1	Very fine argillaceous sand.
80	4	White sand and white clay.			

The section, down to the 49 feet level (which was sunk as a well) appears to have been in recent alluvium, as the pebbles are mostly of a quartzite type,

while those below that level are almost invariably of white quartz, a feature that is common to the ancient river deposits in general. The boring does not seem, at the 156 feet level, to have penetrated the full thickness of these beds.

Further information as to the deposits on the plain adjacent to the above was kindly supplied by officers of the Mines Department. In Gawler South three wells were sunk, following a north and south direction, passing through alluvial deposits to 120 feet, the last 20 feet was in gravel. Another well, a little further to the south-west, gave a similar section, with the bed of gravel a little deeper. Two other wells situated south-westward of the racecourse, in Section 3,220 [Hd. Munno Para], a little more than a mile from Gawler East, showed gravel from the 70 feet level to 80 feet, resting on white clay. Another well, situated in Section 3,215, about one and a half miles from Gawler East, in a south-westerly direction, contained a bed of sand and gravel between the 100 feet and 130 feet levels. Another, a little further to the westward, had a thin bed of gravel at the 45 feet level, and another of 4 feet, between 72 feet and 76 feet.

There can be little doubt that the section passed through in the Waterworks yard, at Gawler, represents a downthrow of the alluvial beds seen in the upcast in the face of the scarp; but it is not so easy to define the stratigraphical relationships of similar alluvial beds at a greater distance.

Gavin Scoular (5) has recorded the results of several well sinkings on the plain, southwards of Gawler. At two and a half miles distant from the latter township, in Section 3,205 [Hd. Munno Para] a shaft was sunk; and at a further four miles, in a south-westerly direction, Section 4,151 (a mile and a half south-eastward from Smithfield), two shafts were put down, all of which gave the same records, *viz.*, the first 80 feet consisted of a "calcareo-argillaceous material," below which was a "semi-consolidated white-yellow siliceous sandstone" that was proved to a further depth of 40 feet without reaching its base. The description of the last-named formation is suggestive of the ancient consolidated alluvium, and may be an extension of the deposits of a similar type that are exposed at Gawler.

Roseworthy Agricultural College is situated about three miles southward of Wasleys, and six miles north-westward of Gawler. The alluvial remains at the latter township occur, apparently, on the eastward margin of the ancient river valley, while Roseworthy College farm is situated nearer the longitudinal centre of the old river channel. In passing from Wasleys, in a south-westerly direction, the surface features become increasingly sandy, and, in places, too loose for cultivation. South-westerly from the college numerous ridges of white sand occur that are the remnants of ancient sand-dunes, held in position by the conservative influence of the primeval scrubs. These are particularly numerous for about two miles on either side of the Gawler River, in the direction of Carclew, Virginia, and Angle Vale. Indeed, the whole of the coastline, from the Lower Light to St. Kilda, is covered with fresh-water deposits.

Particulars of a boring put down on the Roseworthy College grounds have been kindly supplied to the writer by the scientific staff of the institution, as follow:—

Height above sea level, about 320 feet.

Depth from surface, in feet.	Strata.	Thickness, in feet.	Depth from surface, in feet.	Strata.	Thickness, in feet.
1	Surface soil	1	302·5	Sandstone	27
5	Limestone	4	303	Gravel	0·5
200	Clay	195	492	Sandstone	189
250	Sandy clay	50	529	Grey clay slate	37
275	Sand	25	607	Hard quartzose sand	78
275·5	Gravel	0·5		Completed 26/10/89	

From the above Log the alluvial beds appear to have a thickness of about 490 feet.

In nearing the coast the surface features become more uniform and pass into extended plains that have had a composite origin, both terrestrial and marine, the material being, from time to time, commingled or rearranged, according to changing conditions. In following the ancient fluviatile channels through such a region, dependence must be placed on what data can be gathered from wells and borings, and these are of doubtful value where the alluvial fans from the higher ground overspread the lower. The two following may be quoted:—

St. Kilda Bore.—Information supplied by Mr. F. McCauley (of the firm, O'Loughlan, McCauley, and Smith, Contractors), Section 5,013 [Hd. Port Adelaide], two and a half miles from the coast; thickness in feet: red clay, 130; slate-coloured clay, 10; very fine white sand, 30; clay, 6; dark, tough sand, 50; fossiliferous dark sand, 10; dark rock and boulders, 5; sand with overflowing water (?).

Sir Sidney Kidman's Bore.—Information supplied by Mr. F. McCauley. Situated about half a mile southward of Penfield, and between three and a half and four miles north-easterly from St. Kilda Bore. Passes through similar beds as at St. Kilda and at similar depths, but was continued a little further than the latter. Total depth, 280 feet. Samples of the fossils from both the St. Kilda and Kidman's bores were supplied to the writer, which yielded nine genera of mollusca and the foraminifer, *Orbitolites complanata.* The latter, from St. Kilda, is a particularly fine and robust example, measuring 21 mm. in diameter and 2 mm. in peripheral thickness. The fossils have an Older Pliocene facies.

III. ROBERTSTOWN, NURIOOTPA, BAROSSA, HOPE VALLEY, BLACKWOOD, AND NOARLUNGA CHANNEL.

(1) Robertstown, Point Pass and Eudunda.

The physiographical factors that characterise the eastern limits of the Mount Lofty Ranges resemble closely those that occur on the western side. An abrupt scarp, facing east, with step-faulting in a throw-down to the Murray Plains, may be compared with the western scarp of the ranges near Adelaide, only in more subdued relief. The down-throw on the western side, to the valley of the gulfs, has given most of the existing rivers a transverse direction to the westward, while the down-throw to the eastward, on the eastern side, has diverted the drainage, in a transverse direction to the eastern lowlands, as with the Baldina Creek, Burra Creek, Deep Creek (Eudunda), Pine Creek (Dutton), and many others. In this north-eastern country an ancient peneplanation, coupled with earth movements tending to depression has obliterated the older river channels, resulting in featureless plains, deep alluvial deposits, and a riverless region.

In the Hundred of English, at the base of the eastern scarp, the ancient waterway, on that side, becomes more defined. At Robertstown, on the valley-plain, and Point Pass, at the base of the ranges, there is a very distinct down-throw to the eastward with a repetition of beds. These earth movements probably occurred during the life-history of the now extinct river. This is suggested by the very juvenile physiography of the district, seen in the steepness of the scarp, and while the latter is incised by scores of small impetuous streams in their descent to the valley, none of these streams have worked back their head-waters sufficiently far as to capture the streams of the plateau at the back.

The valley, on its eastern side, is bordered by a range of rounded and lower hills, which become more defined as they pass to the southward. At present there is no distinct north and south drainage in the locality. The torrential streams that come down the scarped face, on the west, are speedily absorbed in the alluvial of the valley, but, in wet seasons, the water gathers into swamps and temporary pools [7, p. 347].

The valley passes Eudunda [Deep Creek] on the eastern side of the township, and continues through Neales Flat, with only fragmentary and intermittent streams that follow an easterly direction.

(2) Dutton.

Pine Creek, the most important waterway of the district, intersects the Hundred from west to east, passing through the township of Dutton. The sides of the creek show thick alluvial sediments. The lower nine feet consist of a very tenacious white and yellow clay, on which rest twelve feet of sand and gravel. It is possible that the basal clay over which the stream runs represents the local slates in a highly decomposed and kaolinized condition.

Consolidated Alluvia near Dutton.

(a) About one and three-quarter miles on the northern side of the township of Dutton, in Section 262, Hundred of Dutton, on the eastern side of the road, there is an extensive show of consolidated alluvium covering one and a half acres. On the southern side of the deposit the stone is fine-grained and very siliceous, exposed in compact masses with chalcedonic lenticles; and on its northern side changes to a coarse conglomerate. It is on a rise in the field and is visible from the road.

(b) In the same Hundred (Section 35, Water Reserve), two miles to the south-westward of Dutton, there is a considerable patch of the old alluvium, similar to that last described, but more ferruginous. Further examples of a similar kind occur in large pieces by the side of the road, three miles to the south-west of the last named, in Section 242, on the boundary line between the Hundreds of North Rhine and Moorooroo, south-westward of Truro.

From the last mentioned situation the ancient river channel can be traced across the northern portion of the Hundred of Moorooroo, following the western side of Stockwell, where the valley is three miles wide. Its remains are very pronounced, going southward, through the Hundreds of Belvidere, Nuriootpa, and Barossa. The township of Stockwell is situated at the base of the eastern ranges of hills [near Truro] in which the Stockwell Creek and St. Kitt's Creek take their rise, flowing north-westerly, to the River Light. The valley, occupied by these and other creeks, appears to be connected with an older channel of drainage coming in from the north, in a course almost parallel with the Robertstown-Eudunda unit, with which it junctions near Stockwell. This will be dealt with in the next section.

(3) North-western Tributary: Upper Light and Kapunda Districts.

The River Light is another of those interesting rivers that are superimposed on the older system of drainage. It takes its rise on a low water-parting in the northern areas of the Hundreds of Saddleworth and Waterloo. In its upper reaches it follows within the limits of an ancient meridional and mature valley, as a sluggish and very serpentine stream with mud banks for 16 miles, southerly, to the township of Hamilton. Here its characteristics entirely change. It takes a sharp turn, in an easterly direction in a course transversely to the physiographical grain of the country, until at the end of 9 miles it impinges on high ranges, near Hansborough, which causes it once more to take a southerly direction, and then westerly, in a great loop. The disturbing factors which impelled the change in its course were, probably, in the first instance, the faulting down to the range on the eastward (such as occurred in other similar situations, further to the southward), which drew the drainage in that direction. Then, being diverted by the highlands on the eastward, it was driven in a reverse direction, which brought it

under the control of the great down-throw on the western side and to the western sea, as has happened to all the others of our upland rivers.

It is quite impossible that the older river, that excavated the broad and mature valley in which the River Light began its course, could have taken the erratic course of the latter in its lower reaches, for from the time The Light made its easterly divergence it developed the features of a juvenile stream eroding for itself a narrow and rocky gorge, except where it intersected the sediments of an alien hydrographic system. We must, therefore, look for the southerly extension of the older fluviatile channel in a direction more consistent with its physical relationships than that presented by the present River Light.

The head-waters of the former river, in addition to the main channel now occupied by The Light, included two other lateral streams now represented by the Tothill Creek and Julia Creek. The three probably converged and formed a united stream down the valley of the present Allen's Creek, which reaches The Light a little to the south-eastward of Kapunda. The valley is continued in the same direction, but with a reversed grade, on the opposite side of The Light, now drained by the St. Kitt's Creek, the Stockwell Creek, and others.

Consolidated Alluvia near Marrabel.

The township of Marrabel is situated on the boundary between the Hundreds of Gilbert and Waterloo, seven miles east by north from Riverton, on the Upper River Light, near its junction with the Tothill Creek. A half-mile from the township, on the road going easterly, a group of large stones was observed on the roadside, facing Section 1,122 [Hd. Waterloo]. The most of the stones consisted of a fine-grained alluvium consolidated to a siliceous compact rock. The stones had probably been gathered from the adjacent grounds. At a quarter of a mile further, in the same direction, a large mass of a similar rock was observed on the opposite side of the road. About one mile distant from the township, in Section 1,131, on the southern side of the road, there is a large patch of the consolidated alluvium showing a rough exposure, which, above and a little below the surface, covers an area of two acres. The stone is a ferruginous conglomerate showing white quartz pebbles and river sand held in a dark-coloured cement. Blocks of the material were exposed that weighed many tons, while the softer portions had been quarried out for road metal, with an exposed face of nine feet in height.

(4) Stockwell.

The township of Stockwell is situated, as already stated, at the base of the eastern ranges of hills in which the Stockwell Creek takes its rise. At this point two valleys converge. One, already described, comes in from the north, *via* Eudunda and Dutton; the other comes in from the north-west, *via* Kapunda and Koonunga; the Spring Creek Ranges forming the eastern limits, and the Greenock and Moppa hills form a low barrier on the western side. The country, situated between, is low-lying and boggy, receiving the flood waters of the Stockwell Creek, Moppa Creek, and St. Kitt's Creek. The road that crosses this low-situated ground (the "back road" to Kapunda) is known as the "Bog Road" and is often under water and impassable. The country is sandy, forming part of the extinct river channel, but is rendered retentive by the sediment brought down from the higher ground by floods. This low area, situated in the neighbourhood of Neukirch, probably marks the spot where the north-westerly tributary made its junction with the main stream.

Considerable sedimentation has occurred in this ancient waterway. Near Koonunga, six miles to the south-eastward of Kapunda, the St. Kitt's Creek has washed out an extensive area in finely stratified alluvium and small gravel, showing vertical river cliffs, up to 40 feet in height, without exposing the base.

(5) Nuriootpa.

From Stockwell, southwards, the country widens out into an extensive plain, characterised chiefly by sandy sediments representing the channel of the combined streams, now extinct, described above. At five miles southward from Stockwell, Nuriootpa, in the Hundred of the same name, is situated near the centre of the plain bordered by the Angaston Ranges on the eastward, and the Greenock hills on the westward. On the western side of Nuriootpa there are low and broad ridges of white sand that have been brought under cultivation as vineyards and orchards. The local cemetery is in these sands.

This country has been interestingly described by the late J. G. O. Tepper [9], who for a time was schoolmaster at Nuriootpa. He says: "The township itself stands upon a fertile sand, gradually merging into the sandhills west and north-westward. South and south-east, more or less loose, either fertile or almost barren sand prevails to within a mile of Tanunda. Below the sand and mould, which are of slight thickness at places or missing altogether, follows first a yellowish, sandy, and gravelly clay, in many places sufficiently pure and plastic for bricks, and from 20 to 40 feet or more thick. Underlying this, and occasionally rising to the surface, is a white and blue very adhesive clay, here and there stained deep rusty, and which is remarkable on account of including layers of impure salt, associated with thin hard layers of ferruginous cement. Even the wells become brackish and finally undrinkable in those areas which have this formation. Under the blue clay follows a white, yellow, or red sandstone, porous and water bearing, but of unknown thickness, nor is it known what is below it, as at a depth of, I believe, about 200 feet, reached by boring near the hotel in search for kerosene or coal, the base rock was not reached."

(6) Tanunda.

The township of Tanunda is situated on the left-hand banks of the North Para (or Gawler) River, five miles to the southward of Nuriootpa. The intervening country is a continuation of the same general features with a considerable development of the hydrous oxide of iron as a cementing agent in the alluvium. Tepper [*loc. cit.*, p. 27], in referring to this deposit, says: "In structure it varies from that of a real sandstone, finely and evenly grained, to a coarse conglomerate of pebbles three to six inches in diameter. Sometimes cavities, as if shells had been removed, are found in it, but no fossils were ever seen here, except a fragment of wood converted into brown haematite, found south-west of Tanunda."

This so-called "Ironstone" is found, sporadically, throughout the district. In Section 124 [Hd. Nuriootpa], situated a little to the northward of Tanunda, the house of Mr. W. R. S. Dempster is situated on a hill, the surface of which consists of a very dense layer of this ironstone conglomerate, which prevents cultivation. Similar exposures can be followed for several miles. On either side of the public road, bordered by Sections 631 and 682, workings for alluvial gold are in progress, while a little further to the southward, in Section 698, on a scrub hill, there is a quarry in a 3-foot layer of fine ironstone gravel that is used for building and road purposes. There are many such workings in the neighbourhood, and the majority of the buildings in Tanunda and district have been constructed with this material.

(7) Rowland's Flat.

The North Para River runs from Tanunda in a south-south-west direction for five miles, to Rowland's Flat, where it takes a reversed direction to the northward, forming the south-eastward extremity of the Hundred of Nuriootpa. The peninsular-like area within this river bend consists of a hill of sand of remarkable extent. The area is, half a mile in width, and a height of about 160 feet above the river which flows at its base. The South Australian Government, when constructing the bituminised road through the district, obtained many thousands of

tons of sand from this source, which has made little impression on the quantity available. The workings at the excavations show a thickness of about 70 feet, without any evidence of the base. The exposure, on the face, shows a top layer of 12 feet of pure white sand, under which is a thicker layer of iron-stained sand.

The presence of the chalcedonized variety of the consolidated alluvia did not come under my notice in this district, although the ferruginous variety is very common, but Tepper [*loc. cit.*] records its occurrence as "a hard grey sandstone grit, cemented by silica, fringing low ridges"; and "a similar but more jaspery rock on the hillsides near Sheaoak Log, showing numerous root-like enclosures."

The North Para River, which has followed the ancient valley from Nuriootpa to Rowland's Flat, after leaving the latter, makes a sharp turn to the westward, by which it passes from a valley of mature features to those of a juvenile stream, and excavates for itself a canyon in the rocks of the Adelaide Series. This divergence to the westward was caused by the tilting of the Gawler-Barossa faulted block, which raised a modified scarp-face along its northern edge, that formed the left bank of the North Para, subsequently reduced by weathering to its present softened features.

The river intersects sediments, older or newer, in its course. At Rosenthal there is a washout of 30 feet, going down to the river. At this point the river banks consist entirely of alluvium, up to 40 feet in height, but a little lower down the stream the bed rock again appears. Near the first bend, southward, on the left bank, there are large water-worn pebbles of quartzite forming an old terrace, now under cultivation, 50 feet above the level of the river. The older rocks have a very consistent dip to the eastward; that is, to the base of the Barossa fault-scarp in that direction.

(8) Lyndoch.

The railway, which follows the North Para River from Nuriootpa to Rowland's Flat, leaves it at the latter place and continues on the ancient river-flats, through the low, sandy country to Lyndoch. Shortly before reaching the latter township, from the north, it has to make a horse-shoe bend, following the edge of the higher ground to avoid a low, swampy area on the northern side of the township. From the latter it continues through sandy country to Sandy Creek, where this class of country widens out into the Barossa alluvial mining district.

(9) Sandy Creek.

Sandy Creek railway station is situated six miles to the eastward of Gawler. On leaving the former of these stations, the line, on an incline, passes rapidly from a country of upland features to a sandy valley, or plain, which is still mainly covered with its primeval scrubs that is gradually being encroached upon by cultivation. The creek, which is only a shallow ditch, is choked with sand and only runs after heavy rains.

Throughout this wide valley-plain, from Stockwell to Sandy Creek, all the cuttings, whether by railway, rivers, streams, and roads, except where these impinge on the rises that mark the boundary of the ancient valley, are in alluvial deposits. Tepper suggested the former presence of lakes in this country, which is highly probable.

The comparative absence of coarse gravel and the great thickness of finer material throughout the district, indicate a weak transporting agent, which may have been in the form of local base-levelling, tending to develop lakes. The presence of layers of salt in the alluvium points to intermittent lagoons, and the hydrous oxide of iron would form under certain conditions as bog-iron-ore. Its presence at the surface, as a cementing agent, may have been caused by capillary action, from a soluble solution, much as travertine forms at the surface over a calcareous subsoil.

(10) Barossa and Adjoining Hundreds.

The ancient river system that is so well represented in the alluvial deposits of Nuriootpa, Tanunda, Rowland's Flat, and Sandy Creek districts, seems, at one stage in its history, to have made a breach in its channel and overflowed in a south-easterly direction, covering most of the Hundreds of Barossa and Para Wirra with some portions of adjoining Hundreds; the ancient river bed being represented by the present secondary hill-tops, which are extensively capped by its sediments.

The westerly limits of this area occur in the neighbourhood of the Sandy Creek railway station. By following the road from the latter in a south-easterly direction, the country is very sandy and has a tendency to drift. Mr. R. Paine, postmaster at Cockatoo Valley, informed the writer that he had sunk a bore on his premises to a depth of 60 feet in drift sand, but failed to reach the bottom of the deposit.

As an alluvial mining field the Barossa district has been examined and mapped with considerable detail by the Mines Department, under the late Government Geologist, H. Y. L. Brown [2], and his assistant, H. P. Woodward [3 and 4]. These writers make a distinction between the Older Gold Drift, which caps the hills, and the Newer Gold Drift, which occurs in the gullies and flats, probably by a redistribution from the older deposits.

Mr. Brown gives a general description of the beds in the following terms: "These Tertiary deposits consist of cappings of ferruginous sandstone, conglomerate, sand, clay, and quartz gravel, resting on the bed rock, sometimes in small outlying patches, at others forming large continuous sheets. They are the portions which have escaped denudation (by the action of the present drainage system) of the ancient rivers or water-courses which in Tertiary times drained the surrounding country. They occupy various positions, in some places forming cappings on hills, in others filling valleys; the difference between their surface elevation being sometimes as much as from 150 feet to 200 feet. This leads to the idea that some of the elevated cappings may be of greater age than the main deposit which lies at a much lower level, although in most cases this is not so, as the high level cappings are connected continuously and can be traced down to, and found to unite with, the latter. . . . From the widespread nature of these beds it seems likely that they mark the position of lakes, or a chain of waterholes, in which the gravel, sand, and clay denuded from the surrounding ranges was gradually deposited. The smaller cappings at a distance from the main body seem to point to the probability of the whole area in the vicinity having been under water. Of the smaller areas of Tertiary formation the most important is that which extends from Section 3,028 to Gawler, where it occupies a wide area between the junction of the North and South Para River." [2, p. 3.]

Mr. Woodward extended the field-work of the Department into the southwestward portions of the Hundred of Barossa and where the auriferous beds crossed the South Para River into the western portion of the Hundred of Para Wirra, which included portions of the Humbug Scrub [3]; and in a further map [4] into the eastern portions of the Hundred of Para Wirra, lying to the southward and eastward of Mount Crawford. Under the heading of "The Older Gold Drifts (Made Hills and Capping)" Mr. Woodward states, these "are ferruginous conglomerates, sandstones, claystone (cement), sand, clay, gravel, etc. These rocks cover a large area of this district, particularly in the eastern portion, where they form all the low hills, and flank the range to the south-east. This formation appears to be the remains of what was a lake bed in Tertiary times; levels, carefully taken, show that there was no outlet low enough to drain the central part until the present (South Para) river gorge cut its way through. The lake probably overflowed at the low saddle, towards Springton, and was fed by various tributaries, portions of the beds of which are still left, one of which comes

down from Blumberg [Birdwood] cemetery; there are also two others coming from a south-west direction" [4, pp. 1, 2].

While Mr. Woodward seems to favour the view that the eastern portions of the ancient drainage had an outlet to the eastward, in his "Notes" on the western portions of the field, he assumes that the outlet, on that side, was to the westward. He states: "During the Tertiary period the main range was out of water; but two main streams flowed, one on each flank, into which small gullies probably ran. Both these creeks flowed north, as is proved by the level of their old beds descending in that direction. The one on the east side seems to have risen somewhere near Mount Gawler, thence flowing in a northerly direction, its course being now traced by a few outlying patches of made ground, and by a general line of low country crossing the present creeks. The other had its rise somewhere to the southward and passed on the west side of Mount Gawler and flowed northward towards the Humbug Scrub, where, at the head of Leg of Mutton gully, it was joined by the eastern stream. Thus increased in size, it flowed across the present river of the Barossa goldfield, and so on, in a north-westerly direction, to Gawler, where it discharged itself into the sea" [3, p. 1].

From the abnormal features pertaining to the extensive alluvial deposits of the area under consideration, it may be inferred that they are the consequence of certain crustal movements that revolutionized the former local drainage system. That large sheets of fresh water followed these movements is evident from the extent of surface that is still covered with fluviatile sands. It is significant that these lacustrine and fluviatile remains are carried on the great Barossa fault-block, and it is probable that the two things had a physiographical relationship. There seems to be two possible explanations. One of these might arise from the tilting of the fault-block down to the eastward, by which the waters of the Nuriootpa river were temporarily drawn off in that direction; or by the elevation of the Barossa Ranges in association with such a tilt created a new watershed with a confined drainage until the rising waters cut out for themselves channels through the barrier. This seems to have been effected by the rivers North and South Para (characteristically juvenile streams), and these effectively drained the area. Mr. Woodward's suggestion that one such stream, flowing westerly, discharged its waters into the sea at Gawler, as quoted above, is inconsistent with the geological evidences. It is true that marine deposits of Miocene age occur at Gawler, but the sea of that period had retreated from the locality long before the adjacent fluviatile deposits were laid down. The levels, quoted by Woodward, may have no correspondence with those that existed under the older physiography.

(11) One Tree Hill.

Extensive ancient fluviatile deposits occur on the eastern side of the Hundreds of Munno Para and the adjoining western side of the Hundred of Para Wirra, intersected by the Tenafeate Creek. This area may be considered as the south-westerly extension of the old fluviatile deposits seen in Barossa and their junction with the main river course that followed the One Tree Hill and Hope Valley channel.

Three miles, in direct measurement (south-easterly) from Smithfield the road reaches the top of the western scarp of the Adelaide Ranges. A strong quartzite faces westerly, near the crest, and just beyond are impure limestones. The plateau-form of the foothills, the ancient river level, is well seen from here.

The sandy country begins a little to the westward of the township of One Tree Hill[2] [Hd. Munno Para, Secs. 4,193-4,230]. A compact white sand-rock

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[2] The "One Tree Hill," from which the township takes its name, and as shown on the map, is situated about a mile to the westward of the township.

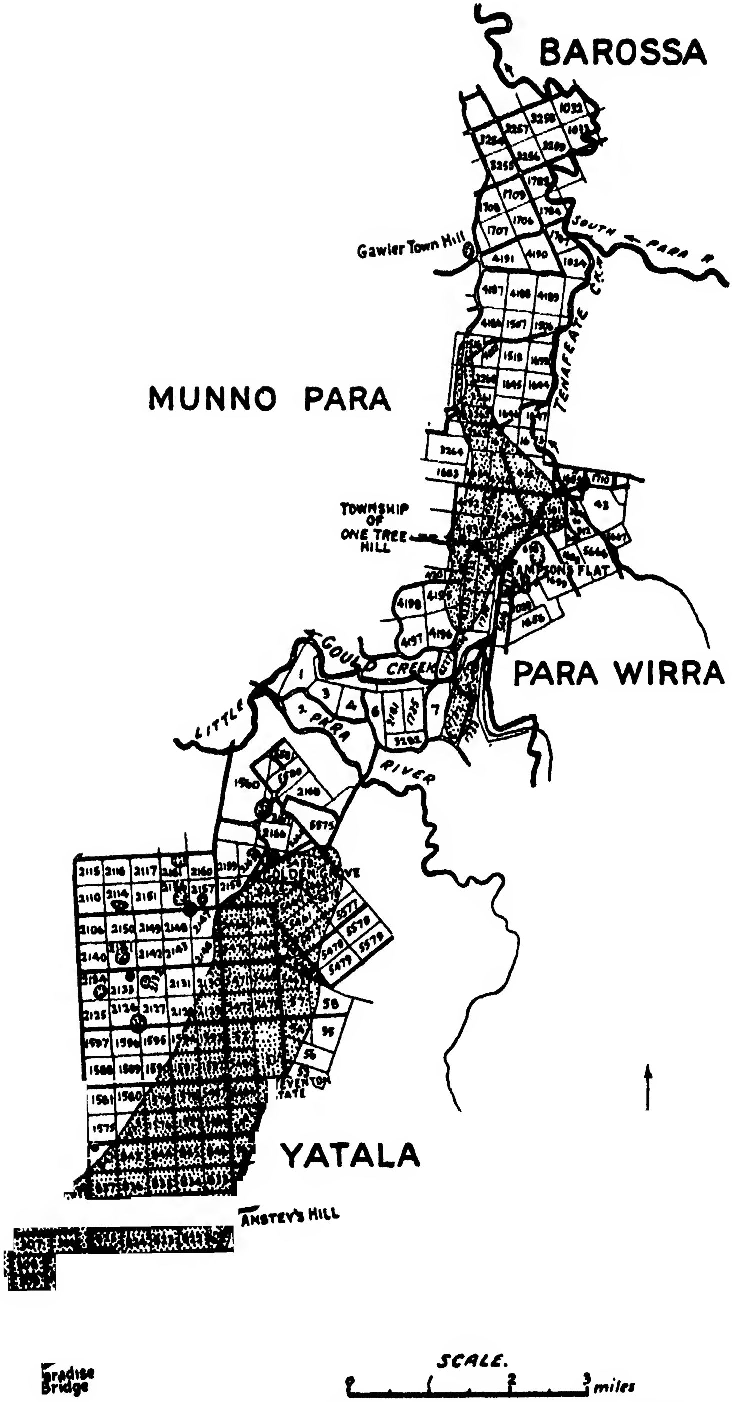


Fig. 2. Parts of maps of the Hundreds of Munno Para, Para Wirra, and Yatala, on which are stippled the positions of alluvial remains of an ancient river, now extinct, that formerly flowed through these districts. Isolated areas occur, on rises, marginal to the valley.

outcrops on the road. This sand patch goes in a northerly direction to Sections 3,267 and 1,516; and at a further distance of about a mile and a half in the same direction, forms a sandy cap on the summit of Gawler Town Hill. [See fig. 2.]

The main patch of this sandy area (much of it still left in its virgin condition) preserves an uninterrupted spread in a north and south direction for nearly four miles, and its greatest breadth, extending into the Hundred of Para Wirra, of two miles. Mr. H. H. Blackham (to whom the writer is much indebted in examining this country) has his residence near the easterly limits of the formation, in Section 6,382 [Hd. Para Wirra]. Near the house Mr. Blackham has a gravel pit, from which was exhumed part of a silicified tree trunk that measures 4 feet 6 inches in length and has a circumference of 4 feet. This specimen is in the macerating yard of the Adelaide Museum.

In the adjoining Section, No. 4,363 [Hd. Munno Para], there is a continuous spread of sand and gravel to the One Tree Hill township, and, in places, these have been quarried. On the eastern side of Section 6,381 [Hd. Para Wirra] there is a strong outcrop of the gravels, forming a flat-topped hill with a steep scarp face. A shaft 30 feet deep has been sunk on the face of the slope (at the base of this scarp) showing eight feet of coarse gravel at top, then five feet of finer, white quartz gravel, and then fine reddish sand, at bottom. Examples of silicified wood were discovered on the surface of the sandy plateau. The thickness of these ancient alluvial deposits, when judged by the difference in height between the height of the sand-topped hills and the depth proved by the valleys and the wells sunk, cannot be less than 200 feet. Cappings on the hills along the eastern margin extend the area, as shown on the accompanying map, fig. 2.

In following the scrub road from Mr. Blackham's, in a south-easterly direction, with Kelly's Gully to the left, the road passes over a ridge of sand, etc., and rises to the top of a conical hill on the dividing line between Sections 79 and 80 [Hd. Para Wirra], which also shows a capping of sand; from which point, in a southerly direction, at a distance of about two miles, is Mount Gawler [distinct from Gawler Town Hill], which has a height of 1,789 feet above sea level. The Mount Gawler Range was probably one of the heights that was above the freshwater level when the auriferous and other alluvia were deposited in the neighbourhood.

(12) Sampson's Flat and Southwards.

After passing through One Tree Hill township in a south-easterly direction the road descends sharply to Sampson's Flat, on the western borders of the Hundred of Para Wirra, bordered on its northern side with sandy deposits. On the southern side of Sampson's Flat the drainage goes southward to Gould's Creek [the northern branch of the Little Para]. There is a small water-parting between Tenafeate Creek and a small creek which runs into Gould's Creek, from the crest of which there is a good view of the plateau country, bordered on its eastern side by the prominent Mount Gawler Range.

On leaving Sampson's Flat, going southwards, and crossing Gould's Creek, the road enters the Hundred of Yatala at its north-eastern angle, rising to a steep hill. Passing over the crest, very hard siliceous and ferruginous consolidated river sands and gravels outcrop on the road and in paddocks on either side [Secs. 1,732-1,733]. In Section 1,733 the gravels are quarried, showing a face of 12 feet in thickness without exposing the bottom. In Section 1,732 there are extensive outcrops of similar deposits on the top of the hill and along the slopes, not less than 30 feet in thickness.

(13) Anstey's Hill Road (Highbury).

No ancient fluviatile remains were noted in the rough country forming the upper region of The Little Para River, but at a distance of about two miles, south-

ward from the last recorded exposure, they appear in the neighbourhood of Golden Grove and are continued southward to the Hope Valley reservoir [see fig. 2]. For convenience this area will be described in a reversed order, beginning at the metropolitan end.

The Anstey's Hill road crosses the River Torrens at Paradise at a height of 200 feet [military map] above sea level. As the road rises to the hill, decomposed slates of the Adelaide Series show in a cutting on the road, with a dip. E. at 62°. At a little higher level examples of a ferruginous quartzose conglomerate occur, in isolated pieces, by the roadside.

Soon after passing the Hope Valley reservoir there are more striking evidences of the fluviatile remains by the occurrence of sand, sand-rock, and fine gravel. Three well-marked river terraces can be recognised.

First River Terrace.—This accords with the flat on which the Highbury Hotel is situated, two miles distant from Paradise and at a height of 450 feet above sea level. The terrace extends over several Sections. Opposite the hotel, a by-path goes down the side of the hill towards the river. Along this path the alluvial beds are exposed in an estimated thickness of 100 feet; and these, again, rest on the slates, at about 100 feet above the level of the river.

Second River Terrace.—About a mile on the rise from the hotel is a second terrace, on the western side of the road, forming part of Hope Valley, which is preserved in its natural condition [1906] with a characteristic flora of Grass Trees [*Xanthorrhoea*] and associated plants that have their habitat on sandy soils.

Third River Terrace.—This is the most distinct and remarkable of the three terraces, at a height of 650 feet above sea level. It occurs on the eastern side of the road with an extensive flat top and scarped face to the westward, ending in a steep cliff on the southern side. The rock varies from a soft sandstone to a hard quartz conglomerate, resting unconformably on the rising ground of old rocks to the eastward [pl. iii., fig. 1].

Anstey's Hill forms the summit of the road, immediately following the highest terrace of the old river deposits, and marks the average plateau elevation of the ranges at 1,300 feet. The hill consists of a very thick quartzite that can be correlated with the Black Hill and Mount Lofty quartzite horizons.

(14) Hope Valley and Golden Grove [fig. 2].

Hope Valley forms the central feature of a well-defined section of the ancient river course that comes down from the One Tree Hill and Nuriootpa districts, following a south-westerly direction. Hope Valley represents a valley of erosion that has passed through three stages. The first of these was inaugurated when the former river excavated its bed in the slates of the Adelaide Series, to a depth of over 200 feet. A period of alluviation followed as a second stage, during which sediments were laid down to a thickness of over 300 feet. Then a second period of erosion took place, when a new channel was cut in the older fresh-water sediments, to the extent of 100 feet, as exists today. Only small transverse streams occur in the valley at the present time. The presence of lignitic material in the sediments has led to numerous bores being put down that have supplied interesting information as to the deposits.

An Adelaide syndicate put down three bores to test the existence of lignite. The first of these was in Section 827 [Hd. Yatala], situated three-quarters of a mile to the northward of the Hope Valley reservoir, which proved bed-rock at a depth of 17 feet. A second bore, in Section 308, a little to the westward of the reservoir, reached bed-rock at a depth of 145 feet. A third attempt, made in Section 845, on the eastern side of Modbury, near the western limits of the basin, touched bed-rock at 60 feet. In each of these trials the bore passed through sand,

gravel, and clay, but no lignite. The South Australian Government then undertook investigations, particulars of some of the more important bores being summarized as follow:—

No. 1 Bore [10, p. 10; 11, p. 19].—In Section 2,093, near the public road on its southern side (opposite the reservoir). The bore passed through sand, sandstone, and clay; including 65 feet of drift sand, followed by 43 feet of clay and lignitic material, resting on pipe-clay at a depth of 193 feet.

The Government then put down nine bores in Section 824, situated within a short distance of the north-easterly angle of the reservoir reserve, of which the following particulars give a generalized account of some of the more interesting logs.

No. 4 Bore [12, p. 33].—Passed through red and white sandstone, 29 feet; friable argillaceous sandstone, 108 feet; pebbles, 5 feet 6 inches; lignitic clay and lignite, 57 feet; clay, 28 feet. Rotten slate was struck at a depth of 235 feet.

No. 5 Bore.—Sandstone with a bed of small quartz pebbles, 75 feet; drift sand, 64 feet; sand and small boulders, 5 feet; lignitic clay, etc., 58 feet; bottom, white clay, 8 feet. Total depth, 210 feet.

No. 6 Bore.—Sandstone, pebbles, and drift sand to 105 feet; lignitic clay, 12 feet; coarse white sand, 28 feet; lignitic clay, etc., 37 feet; bottom, white clay, 14 feet. Total depth, 197 feet.

No. 7 Bore.—Sandstone, 85 feet; drift sand, 81 feet; lignite and lignitic clay, 62 feet; bottom, white clay, 2 feet. Total depth, 230 feet.

No. 11 Bore.—Sandstone (containing 11 inches bar of ironstone), 64 feet; drift sand, 77 feet; lignite and lignitic clay, 55 feet; bottom, white clay, 17 feet. Total depth, 216 feet.

It was found that the lignite deposits do not extend eastward much beyond No. 7 bore, as they were not present in bores 9, 10, and 12.

For further information see Government *Mining Review*, No. 33 (1921).

A bore put down at Tea Tree Gully, in Section 5,485 [Hd. Yatala], two miles to the north-eastward of the Hope Valley group, passed through variously coloured clays with quartz pebbles, resting on rotten slate at a depth of 178 feet. The bore was continued to a depth of 341 feet in the upper phyllites and blue metal limestone of the Adelaide Series as bed-rock. [Information kindly supplied by Engineer-in-Chief's Department.] A shaft was sunk on the kaolinized slate, and the latter worked in the interests of the pottery works, at Hindmarsh, for many years.

The old fluviatile valley shallows on the western side and has been reduced by denudation to numerous disconnected patches of alluvial deposits, both fine and coarse, that cap the low elevations [fig. 2]. Gravels of various grades occur under such circumstances in Sections 2,114, 2,141, 2,133, 2,134; and near the cross roads, taking in parts of Sections 2,126, 2,127, 1,596, 1,595 [Hd. Yatala]. A quarry in gravel [Sec. 2,141], near the residence of Messrs. Smith Bros. [observation made in 1909], showed the following section: *(a)* At surface, consolidated gravel, puddingstone, somewhat ferruginous; *(b)* hardish freestone, 4 feet; *(c)* gravel, fine and coarse (coarser below) argillaceous in part, carrying calcareous pipes, 20 feet, resting on variegated pipe-clay. Black calcareous slate and blue-metal limestone show on the roadside, near Smith Bros., on the southern side of Section 2,143, with a dip. E. 20 S. at 35°. The same limestone occurs in a well, near-by, at a depth of 120 feet.

The ancient fluviatile remains in the Hope Valley district form a continuous mantle for many miles. In their southerly limits they pass around the Hope Valley reservoir, parallel with the course of the River Torrens, and then take, as

their easterly margin, the eastern side of the main north-eastern road, rising to the base of Anstey's Hill. From there they follow the western side of the main road to Tea Tree Gully, continuing northwards to Golden Grove, where they curve round to the broken margin of these beds on the western side, as already described, forming a continuous area, seven miles long and three miles wide [see fig. 2]. On the northward side, after an interval of two and a half miles, they reappear in the extensive deposits of Sampson's Flat and the One Tree Hill district. In a southerly direction, two miles to the southward of the Hope Valley reservoir, they reappear on the southern side of the River Torrens, at the Thorndon Park reservoir.

Post-Miocene Age of the Hope Valley Alluvia.

The presence of lignitic material in the bores at Hope Valley might, at first, convey the impression that they could be correlated with similar material discovered by borings at Moorlands and other places in the Murray Plains, underlying the fossiliferous Miocene beds. That these respective deposits are of different geological ages is quite clear. Deposits of carbonaceous matter are a frequent feature in the swamps and backwaters of large rivers in their mature stage, and may be of any age. The following are points of contrast existing between the respective lignitic deposits at Hope Valley and the Murray Plains:—

(a) So far as known, the lignite at Hope Valley is limited to a patch not exceeding a mile in length.

(b) The deposits at Hope Valley show no stratigraphical relationships with the Miocene beds.

(c) Moreover, precisely similar alluvial deposits overlie the fossiliferous Miocene at Happy Valley, Morphett Vale, Reynella, and other localities, as occur at Hope Valley.

(d) The lithological features of the two formations are much in contrast. In the Moorlands district, where over 100 borings have tested the ground, beds of gravel are almost absent, while at Hope Valley they are a frequent feature (up to 26 feet in thickness), occurrences being both at depth and at the surface. Glauconitic sands and clays are common in the Moorlands sections, but are totally absent in those at Hope Valley. Quicksands form thick beds at the latter, but are not present at Moorlands. The alluvial sediments at Hope Valley, including the bores and surface terraces, show a vertical thickness of 400 feet.

(15) A Truncated Segment [fig. 3].

A remarkable tectonic feature is present in the foothills of the ranges in the neighbourhood of Adelaide. A crescentic segment has, by faulting, been let down which broke the continuity of the piedmont plateau, and for a distance of eight miles the foothills, represented by the Glen Osmond-Mitcham quartzites and slates, have disappeared. The horns of this faulted crescentic segment are: *(a)* at the Stockade, in the north; and the other, *(b)* at Marino, in the south. The line of fracture follows the base of the ranges along the slopes of the Three Sugar Loaves, Black Hill, Stonyfell, Glen Osmond, Mitcham, Tapley's Hill, and to the seaboard near Brighton [see fig. 3]. The piedmont plateau, to be consistent with the general physiographical features, should be continuous between the Hope Valley plateau and the Belair-Blackwood plateau. Instead of this, where the foothills ought to show themselves, in this interval, there is an alluvial plain, having the Hope Valley and the Belair-Blackwood sections truncated on either side. Patches of what appear to be remains of the ancient river terraces occur on the slopes of the ranges within the limits of the gap.

A deep boring, carried out by the Municipal Tramways Trust, at Kensington Gardens, near the south-eastern corner of Section 270 [Hd. Adelaide], by Messrs.

Horwood, Bagshaw, Limited, who have courteously supplied the writer with a copy of the Log, is of great interest as bearing on the geological features under discussion.

The following is a generalized record of the Log, showing the beds passed through:—

Depth in Feet.	Thickness in Feet.	
22	22	Sand and boulders—bed of old creek.
60	38	Red clay and gravel.
145	85	Clay and boulders.
285	140	Yellow clay.
290	5	Sand and gravel.
337	47	Boulders in yellow drift-sand.
368	31	White, coarse sand.
436	68	Red sand.
443	7	Sandy clay.
550	107	Black sand.
572	22	Sandy clay.
610	38	Bro
626	16	Brown sand, becoming coarser.
635	9	Sandstone.
667	32	Stiff black clay.
680	13	San ne.
695	15	Cha [(?) Kaolin] clay.
705	10	Gre lay.
720	15	Shaly slate [(?) Bed-rock].
740	20	Lay of clay and white sandstone.
752	12	San

It is possible that the last 47 feet in the above section represent the bed-rock, but the 700 feet overlying this horizon undoubtedly represent fluviatile deposits. The latter are considerably thicker than occur in other bores in the district. At the Dry Creek bore they proved to be 320 feet in thickness; at the Metropolitan Abattoirs, 368 feet; Croydon, 395 feet; Kent Town, 69 feet. If the piedmont plateau, referred to above, which carried a segment of the ancient alluvial beds, was let down by a step-fault, it would receive the wash from the ranges from several creeks that debouch on the plain, which, in association with the older alluvium, may explain the extra thickness of the sediments present in the Kensington Gardens bore. At the same time the 32 feet of "stiff black clay," between the depths 635-667 feet, may represent the impure carbonaceous beds in the Hope Valley sections, and the reported "chalky clay" resting on "shaly-slate" may represent the kaolin, or decomposed bed-rock present in all the Hope Valley bores. If the ancient fluviatile remains have been dropped, as suggested, with the faulted segment, this subsidence has occurred since the Hope Valley river ceased to flow.

(16) The River Torrens.

The question of the relation that the River Torrens bears to the ancient hydrography is full of interest. The river originated on a plateau of comparatively low relief in the process of elevation, and has, by erosion, kept pace with the epeirogenic uplift throughout its life history. The river has its head waters in the neighbourhood of Mount Pleasant, about 22 miles from its outlet at the gorge where it debouches on the Adelaide Plains, eight miles from the city.

The river basin includes the relatively lower ground bordered by the Mount Torrens [1,918 feet] Range and Forest Range, on its southern side; and the Mount Gould [1,725 feet] Range, on the northern. At Mount Pleasant the river flat has a height of 1,400 feet above sea level. Ten miles lower down the stream, at Gumeracha, the river is at the 1,100 feet level, with adjacent heights, on either side, of 1,400 feet. Twelve miles lower down stream, where the river emerges from its gorge, the normal water level is 300 feet above sea level, with adjacent heights within the gorge of 1,400 feet on its northern side and 1,200 feet on its southern.

In the upper reaches, where the rocks are generally more yielding, narrow lateral deposits have been laid down, but when the stream cuts through the hard barriers of rock, near its outlet at the gorge, the river bed is narrow and enclosed

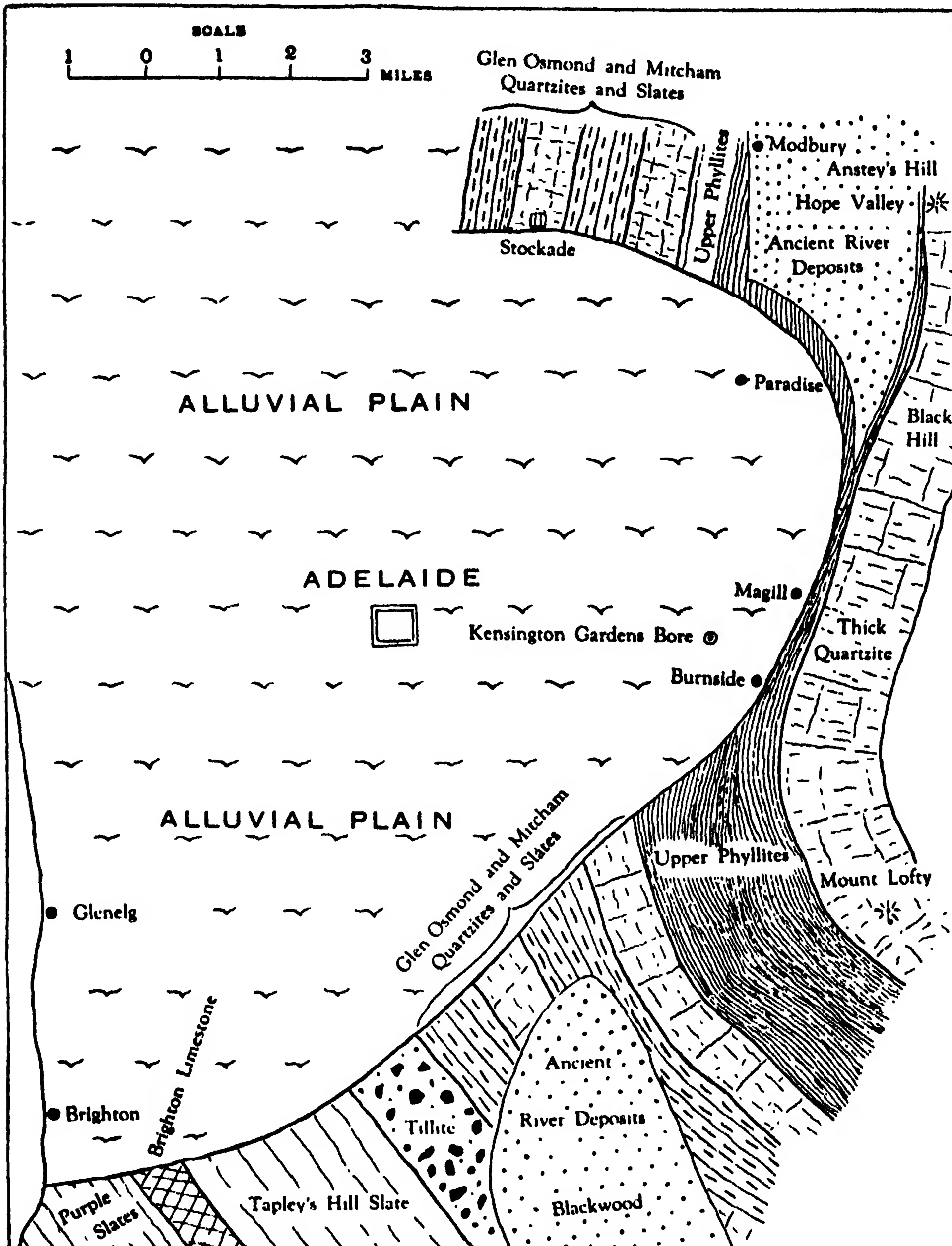


Fig. 3. Sketch plan of foothills, near Adelaide, showing the break in their continuity and let down, by faulting, of a segment, eight miles in length, together with the ancient fluviatile remains on top; also showing the truncated portions of the latter, as cappings, on the platforms on either side of the broken portion. The Glen Osmond and Mitcham quartzites form one bed, but through a synclinal fold are repeated on the plan.

by steep precipitous sides. The absence of waterfalls and river terraces of any account are indications of a youthful stage of erosion. Rapids occur near Castambul, starting at the base of the "Devil's Staircase" and continue down stream for about a quarter of a mile in a fall of about 50 feet. The gorge is cut in the Basal Grits of the Adelaide Series, resting unconformably on the Pre-Cambrian massif. In one part of the rapids is a pothole sufficiently large to allow six or eight men to sit comfortably in it, and in front of the rapids is a hole excavated in the hard rock that goes by the name of the "Devil's Hole," which is said to be 15 feet in depth, probably excavated at the base of a former waterfall that has now been reduced to rapids.[8]

With respect to the geological age of the river, the evidences seem to suggest that it was called into existence under the deformation that was incidental to the elevation of the Mount Lofty Ranges. In that movement the country received a tilt to the westward—a pitch-down in the direction of the fault-trough—which became the controlling factor in determining the lines of drainage on the southern side of the uplift, having a westerly direction.

While the river shows juvenile characteristics, as already described, it is evidently of considerable antiquity, as it has incised its bed through some of the hardest rocks to a depth of at least 1,400 feet. The fact that it has been able to keep its course open to the westward is proof of the very slow movements operating in the elevation of the ranges, and supplies a rough index datum in estimating the age of this Pleistocene (or earlier) earth movement.

(17) Blackwood and Eden Hills.

The steep faces of the Mitcham and Brighton hills mark the limits of the Adelaide Plain on its southern side where the highlands curve round to the coastline. The main South Road rises to the plateau at Tapley's Hill, at which elevation a fine panoramic view of the Belair-Blackwood plateau can be obtained, bounded, on the eastward, by the ranges that form the Upper Sturt platform levels.

The Belair-Blackwood plateau is, really, a broken continuation of the Hope Valley plateau, at about the same level and with similar physical features. The most of the surface in the neighbourhood of Blackwood consists of a loose, sandy soil, especially on the western side from the railway, and southwards. Some parts are under cultivation, while other portions are still in a virgin condition of sandy scrub. On the northern side of the railway station a deep cutting has been made in the beds, partly tunnelled by the railway, showing a face of about 20 feet at the southern end of the cutting, where the alluvial beds rest unconformably on rotten slates of the Adelaide Series.

The beds consist, more or less, of cemented sand-rock, irregularly stained by iron oxide. Lumps of similar rock are widely scattered over the district, indicating the presence of these beds below the surface. In the approach to the railway station an interesting section is exposed [pl. iii., fig. 2] of an ancient river channel filled with fluviatile deposits that are not seen at the surface level and have no relationship to any form of existing drainage.

On the western side these deposits extend to Eden Hills, forming a high-level platform at about 200 feet above the Eden railway station. At this level, a little to the eastward of the Friends' Meeting House, indurated sand-rock is seen on the road and in the gully, on the left. The softer portions of the formation have been excavated for sand.

At a slightly greater elevation, forming the summit of the plateau, in the fork of two roads that include Section 104 [Hd. Adelaide], there is an extensive flat of

[8] In the construction of the new Gorge Road through this narrow defile, much of these interesting rock structures in the bed of the river have been destroyed.

dark-coloured, carbonaceous, sandy clay, very absorbent and boggy, in wet seasons, and deeply cracked during the dry. It could not have originated in such a position, and suggests its former occurrence as a back-water or stagnant pool in a stream.

At Mr. Wade's brickyard, situated a little to the southward of the last named, the following section was noted [Observation made in 1918]:—Top clay (soft), allowing for rise in the ground, 20 feet; mottled clay, 6 feet; white, very fine, indurated sand bed, containing isolated pebbles up to six inches in diameter, 6 feet; giving a total of 32 feet. Bed-rock, rotten slates penetrated by quartz veins.

On the Belair side, a capping of sand-rock is seen in many places. Near the Inebriate Retreat [1904] indurated sand-rock, covered by dark-coloured clay was seen exposed in waterholes, having a thickness of 8 feet, without bottoming.

In a south-westward direction and nearly due south of the Eden railway station, high-level alluvium forms cappings on the flat surfaces on both sides of the Blackwood Creek, south-westward of the Metropolitan brick works; also on the higher levels, bordering the Sturt River, in the same locality.

(18) Happy Valley.

By a curious coincidence the three metropolitan reservoirs, namely, Hope Valley, Thorndon Park, and Happy Valley, are situated within the channel of the ancient river bed, the depression between the ranges being favourable for water storage. The first two mentioned are on the northern side of the great break in the foothills, and the third is on the southern side. Thorndon Park reservoir, which is somewhat affected by the faulted segment, is 100 feet lower than the others, while Hope Valley and Happy Valley are, respectively, about the same height with regard to sea level.

The reservoir at Happy Valley is situated on an extensive ancient river terrace, which forms the floor on which the water rests and exhibits scarp faces on two sides. These remains are among the most impressive of their kind in South Australia. The rock varies from an argillaceous to a siliceous sandstone, of a pure white to a reddish, mottled colour, and from a consistency that is somewhat easily acted upon by the weather to that of a very compact, weather-resisting rock. A channel has been excavated on the southern side of the reservoir to convey the overflow into the Field River. This channel is bordered on its southern side by cliffs of the sandstone rock, varying in heights to 25 feet, which are continuous in a westerly direction for one and a quarter miles. At the south-westerly angle of the reservoir, a bridge on the main road crosses this channel. Here the beds have an exposed thickness of 15 feet, with vertical walls and a solid floor which appears to be impervious to the water resting upon it. From this point the water follows an excavated canyon-like channel, in the same rock, for a quarter of a mile, when it spills over into lower ground as it unites with the natural drainage of the district. The Hope Valley sediments rest on the decomposed slates of the Adelaide Series, while the Happy Valley deposits rest, in part, on the eroded beds of the fossiliferous Miocene.

In 1904, Basedow (13) noted these occurrences at Happy Valley, but described (following Tate) the fossiliferous beds, as Eocene, and the alluvial beds, as Miocene Sandstone.

Evidences of the great width of the ancient river valley are abundant in the surrounding neighbourhood. On the eastern side, opposite the reservoir, thick deposits of sand occur on the slopes towards Cherry Gardens. The cemetery at Cherry Gardens, as well as several of the adjacent Sections, situated at a distance of four miles from the reservoir, has a surface of fine alluvial sand, which may

possibly indicate a lateral tributary of the main stream coming in from an easterly direction. These high level positions seem to connect with those at Blackwood, which are about at the same elevation.

Going southwards from the Happy Valley reservoir the ancient river deposits are continuous for many miles, clothing the floor and sides of a well-defined valley. Immediately adjacent to the reservoir are numerous vineyards, the soils of which are conspicuously sandy. Within half a mile southward of the reservoir, the foot-hills, on the eastern side, show a terrace of the variegated sandstone in which the buildings of the Horndale winery have been set, by excavations, in successive elevations, to a height of 60 feet; and a bore on the premises penetrated the same rock to a depth of 40 feet without reaching its base. At a further distance of three-quarters of a mile in a south-westerly direction, as reported by Basedow, a bore put down at the Vale Royal winery passed through 30 feet of the same kind of rock without reaching bottom.

(19) Reynella, Morphett Vale, and Hackham.

The ancient river valley in this neighbourhood tends a little west of south with a gentle down-grade in that direction. There is no longitudinal drainage in the valley, and the streams that debouch from the hills on the eastern side are rapidly absorbed as they reach the valley flats. The Adelaide-Willunga railway follows the western side of the valley, passing through many cuttings between Reynella and Noarlunga, most of which are in the alluvial deposits of the extinct river. The following occurrences may be noted:—

(a) One mile before reaching Reynella from the northward, the main south road passes by a bridge over the railway where the latter runs through a deep cutting of the ancient river sediments. These are of a light-coloured, sandy nature, false-bedded; about 20 feet are exposed in the section, and the beds are 424 feet above sea level.

(b) On the southern side of Reynella the railway makes a deep cutting through a ridge that shows a stratigraphical unconformity. The lower 25 feet consist of rotten slate, nearly horizontal in the bedding, with a slight anticlinal fold at the southern end of the cutting. Resting on these slates are 15 feet of variegated, fluviatile sand-rock.

(c) A boring at Reynella (on the property of Mr. F. L. Byard, three-quarters of a mile to the southward of the Happy Valley reservoir, and situated on a flat about 40 feet below the reservoir level) was carried out by Mr. E. S. Horwood. The contractor reported that soft sand and sedimentary soils were met with to a depth of 247 feet, including a bed of brown coal, 18 inches thick, at a depth of 70 feet, and another similar bed, 6 inches thick, at a lower level. At the depth of 247 feet the bore entered hard rocks of the Adelaide Series ["The Register," January 3, 1922]. It seems probable that this section could be correlated with the beds passed through in the borings at Hope Valley, referred to above; or, otherwise, the sub-Miocene lignitic series.

(d) At the 18¼ mile-post (three-quarters of a mile southward of Reynella) a cutting occurs in the Purple Slates, 9 feet in height, with a dip of 35° (or more) W.S.W. Portions are much kaolinized. No alluvial remains occur in this cutting. The railway here makes a curve to the south-east that carries the line more into the valley.

(e) At the 19¼ mile-post (three-quarters of a mile before reaching Morphett Vale) a deep cutting, that reaches a maximum height of 35 feet, exhibits some interesting features. With the exception of a few feet at the surface, the whole of the section consists of the characteristic variegated sand-rock, which has been

greatly eroded by rain and has thereby developed a secondary cliff on the face. Differential weathering has produced cavities, stalactitic forms, and deep rain gushes that cause rapid changes in the wearing away of the sides. The cutting is a quarter of a mile long. The base of the beds is not seen.

(f) At the 19½ mile-post, shortly before reaching the Morphett Vale railway station (which is 78 feet lower than that at Reynella), the railway tends easterly towards the present valley flat. On the western side of the railway, near Morphett Vale, the consolidated sand-rock forms a considerable ridge with its slope towards the line. The crest of the ridge is covered by a layer of loose and bleached sand that is partly wind-blown. Near the highest point this sand is about four feet in thickness, under which is a foot of black, rather carbonaceous sand, which probably represents an old surface layer with vegetation. Under this, again, is a bed of yellowish sand, two feet in thickness. The true floor of undisturbed sediments underlies the latter, consisting of the usual indurated sand-rock, carrying, in places, thin layers of travertine limestone. The face of the ridge, towards the valley, is moderately steep, and as the prevailing wind that acts on the exposed side is evidently a south-easterly one, that side of the hill has been bared of sand, exposing the indurated alluvial beds, while the disintegrated sand has been carried by the wind to the crest and spread over the neighbouring fields in that direction. There are several acres bared in this way, and the older alluvial deposits have become deeply channelled by the rain on the slopes of the hill—in one instance the rain has cut out a gutter six feet in depth. This sandy ridge has been the camping ground of aborigines. Several circles of stones were noticed, still in position, that had been used for cooking purposes, and a large number of their chippings were scattered over the bared floor and patches of charcoal occurred in the undisturbed layer of sand at the top. These stone chippings were observed throughout the four feet of loose sand on the top of the hill, and on the bared floor, but there were no signs of them in the indurated sands.

(g) The ridge, on its southern side, slopes down to the Morphett Vale Creek, by which it is intersected, while the old river deposits appear again on the other side of the creek, and are once more exposed by the railway in the first cutting on the line after passing the Morphett Vale railway station, at a quarter of a mile distance from the latter. The cutting shows a maximum height of 40 feet [pl. iv., fig. 1], and with the exception of two and a half feet of surface soil, consists entirely of the usual highly-coloured rock in white and red. A deep red has been the original feature, as to colour, the white patches and vertical lines having been caused by the solvent action of rain water on the iron-stained grains of sand.

(h) The ridge is continued on the eastern side of the cutting, just described, in a gradual slope that extends to the centre of the valley. In this extension of the fluviatile remains the upper portion, having a thickness of several feet, consists of disintegrated sand-rock, more or less wind-blown into hummocks and depressions that carry a characteristic flora of native pines, *Banksia,* and an undergrowth of *Mesembrianthemum.* A space of about an acre has been wind-blown and bared to the top of the red sand-rock, resting on which a considerable number of chipped stones, by the aborigines, occur. As the slope of the ground nears the valley floor the vegetation changes to good-sized gum trees.

At the township of Morphett Vale there is an outlier of the fossiliferous Miocene in the form of glauconitic clay and sands. It can be seen in a road cutting at the back of the township, and was also proved in sinking a well opposite to the institute. Samples from the latter were given to the writer in March, 1886, by Mr. King. These Miocene deposits occur at a higher level than the ancient alluvial beds and were eroded by the former river when cutting its channel.

(i) The next cutting on the line occurs shortly before reaching Hackham railway station. The embankment, connecting the two cuttings, in a length of ten chains, has been constructed entirely of the stone quarried from the cutting near Morphett Vale, described above. The face of the Hackham cutting has a height of about 24 feet and is interesting as showing a stratigraphical junction of the ancient fluviatile system and the fossiliferous Miocene. [Pl. iv., fig. 2.] The latter, at the southern end of the cutting, forms a low anticline with a maximum dip of 5° S. The railway, also, has a gradient of 1 in 45, rising north. This, with the slight rise of the Miocene in the direction of the upgrade, thins out the alluvial beds and the cliffs consist mainly of Miocene. In the latter *Turritella aldingae* is a very common fossil, but as the beds have been letched of their lime the fossils occur only as impressions and casts, the lime, to some extent, being replaced by silica. The alluvial beds are of the usual type and include a bed of small gravel which thickens towards the southern end. The pebbles consist almost entirely of white quartz, much water-worn. The alluvial sand-rock is also calcareous, in places, through proximity to the Miocene, and the latter has also led to the formation of travertine near the surface. At the southern end of the railway cutting the main road comes within a few yards of the latter, and in the road cutting a very similar geological section is seen, as, also, in the ground at the back of the Hackham railway station, and on a district road that goes westerly from the latter. In a low cutting on the main road, on the southern side of the last-named village, a reddish sand-rock is exposed, mixed with travertine.

An Ancient River Bed seen in the Railway Cutting, about a mile before reaching Hallett's Cove from Adelaide.

The bed rests directly on the fine-grained quartzites of the Purple Slates Series. The pebbles in the bed are highly water-worn and vary in size up to two feet, the average being about a foot in diameter. They show a glaze or polish that reflects strongly in the sunlight. They are contained in a darkish-coloured indurated mudstone. The pebbles can be easily dislodged from the matrix and leave behind a smooth surface with a cast of their outline. The exposure is over 100 yards in length. There is no drainage in the neighbourhood with which they can be associated. The stream appears to have had, approximately, a north and south direction, and was, probably, a lateral contributory to the main river that drained the St. Vincent Plain before the incoming of the sea.

(20) Noarlunga and Aldinga.

At a little more than a mile in a south-westerly direction from Hackham, on a north-south district road, between Sections 46 and 47 [Hd. Noarlunga], water-worn pebbles occur on ploughed land about 80 feet above the main road. The larger stones, up to a foot in diameter, have been gathered from the land and thrown over the fence on to the road. Fluviatile deposits also occur on the opposite side of the valley. Here the stone has been quarried to a small extent. The upper portion of the bed, by disintegration, makes a loose and sandy soil.

Approaching Noarlunga and the banks of The Onkaparinga, the ancient sediments are much in evidence. On the road, near the church, where the road goes sharply down to the river level, a bed of gravel, containing large stones, is seen in section. The land along the northern banks of The Onkaparinga is very sandy, while on the southern side of the river the evidences are still more marked. At a height of about 200 feet above the river level the entire surface has a thick deposit of indurated red sand. The superficial loose sand has been removed by the wind, exposing the undisturbed sand-rock that, from a distance, appears as a conspicuous red patch. On this bared ground, deeply eroded by rain channels, many stone chippings of the aborigines were found. [Observation made in May, 1904.]

These deposits can be traced, going easterly, along the southern boundary lines of Sections 72, 19, 20 and 65, following the ridge as far as Section 68 [Hd. Willunga] at Sea View, the residence of the late Chief Justice, Sir Samuel Way, (where indurated gravels surround the house) covering an east and west distance of two and a half miles.

On the main road connecting Noarlunga and Aldinga, as the road approaches the margin of the wide valley on which the latter township is situated, several deep cuttings are passed through in which good sections of the old fluviatile beds are exposed. These beds do not show a dip to the valley but are horizontal and truncated, marking stages when the valley sediments stood at a much higher level than at present.

This great northern river, now extinct, formed a junction with another river that came from the east, now represented, in part, by The Onkaparinga, which will be considered in the next section.

IV. RIVER ONKAPARINGA AND ITS DESERTED VALLEY.

A group of hills around Mount Pleasant, Mount Torrens, and McVitties Hill, with their respective ranges, form an east-west water-parting in which several rivers take their rise. Reedy Creek flows eastward to the Murray, while the Rivers Torrens and Onkaparinga flow westward to Gulf St. Vincent.

The Upper Onkaparinga, as a sluggish stream, flows through open country that has subdued relief, passing the townships of Charleston, Woodside, and Balhannah. Some of the head waters of the Onkaparinga have been captured by the younger and more energetic River Torrens. There is a striking contrast between the Upper and the Lower Onkaparinga. Instead of widening out, as it nears its outlet, it contracts its valley area and becomes an entrenched meander, held within canyon-like walls. This reversal of the usual order in river development is explained by the fact that The Onkaparinga, at one time in its history, changed its course in its lower reaches, forsaking its original channel and excavating a new one.

The point at which this divergence took place appears to have been in the neighbourhood of Mount Bold. The river, after passing the latter, makes a great loop in a sudden turn to the southward, followed by an equally sharp turn to the northward. It was at this most southerly bend that the river appears to have changed its course. Here the high rocks, on its left banks, end abruptly, and an alluvial bank takes their place which, divergently from the river, is continued in valley form for many miles in a westerly direction and carries all the evidences of being the deserted channel of an important river. It is bounded on its southern side, in part, by the Saddle Bags Range, and, on its northern, by the higher ground through which the present River Onkaparinga has its deep-seated bed.

Mr. Durrant, a local gold digger, informed the writer that a shaft had been sunk in Section 305 [Hd. Kuitpo], at the southern bend of the river where the river is supposed to have changed its course, that passed through sand and gravel for more than 100 feet without reaching bed-rock; the upper part of the shaft went through a quartz-pebble conglomerate, evidences of which can be seen on the surface to this day. The width of the ancient alluvial deposits in this locality is defined on its northern side by Sections 756 and 757 (the property of Elijah White and Son[4]) at a height of 270 feet above the level of the river. The most of the hill top is covered with more or less consolidated coarse sand and conglomerate consisting of white, water-worn quartz. The deposits have been worked showing

(4) The personal references in this district were made from observations and notes taken in October, 1908.

a quarry face of 5 feet in thickness, without exposing the base, the material having been utilized in the construction of the adjacent road.

On the southern side of the valley, commencing at the southerly bend of the river, similar material skirts the side of the Saddle Bags Range. A very distinct ancient river terrace with a scarp face of sand and conglomerate continues for some distance parallel with the new road (lately constructed in connection with the building of the weir of the Mount Bold reservoir). The terrace is some 50 feet above the level of the road and its material has been utilized for making the latter.

From this point of proximity to the river the ancient alluvial deposits continue, uninterruptedly, in a south-westerly direction to the margin of Gulf St. Vincent. A line taken across the valley, in the neighbourhood of Clarendon, supplies the following evidences.

On the southern side of Clarendon is a ridge known as Pickett's Hill which runs parallel with the river and is 240 feet above it. At one mile from Clarendon, near the top of the hill mentioned and on the southern side of the crest [Sec. 758, Hd. Kuitpo], a cutting on the road shows a striking section of the consolidated alluvial beds, 14 feet in thickness, resting unconformably on rotten slates. The alluvial beds do not follow the slope of the hill, but are horizontal to the plane of the valley below. At a somewhat higher level than the cutting on the road, the beds curve round slightly to the northward, passing through the grounds of Mr. T. B. Brooks [Sec. 745], following the southern side of the crest of the ridge at a height of 300 feet above the Onkaparinga, but are not seen on the river side of the hill.

At a lower level, going southerly, Baker's Gully and the Kangarilla Flats, including the cemetery and blockers' settlements, consist entirely of sand or coarser alluvial material. On Mr. Edward Steer's ground, Sections 840 and 826, there are large deposits of very clean sand and gravel. In the first-named Section the gravel is about 12 feet in thickness, resting on sand. The pebbles are mostly quartz, limited to two inches diameter, mostly smaller. The coarser sand and such stones as passed through a quarter-inch mesh were obtained here for the cement in constructing the Clarendon weir, amounting to 4,000 yards of material. From Section 826, situated about half a mile from the last mentioned, 600 yards were obtained for the same purpose.

Continuing southwards, on Joseph Oakley's land, in Section 854, a well was sunk in gravel, clay, and marl, to a depth of 20 feet, below which was 20 feet of quicksand which led to the relinquishing of the sinking. Samples of silicified wood were found in this shaft. On the adjoining Section, 166, southwards, owned by C. E. Parsons, 80 feet of quicksand was met with. The well was bricked up, but the run of fine sand between the bricks was so great that the whole quickly collapsed. The line of section, north and south, just described, proves that the ancient river valley at this part was, at least, three miles wide.

What was probably a tributary of the river that formerly flowed down this wide valley, came in from the south-east, between ranges now represented by Mount Panorama and Knott's Hill, on the eastern side, and by Wickham's Hill and low ranges on the western. The writer entered this valley by Stony Nob on the western side of Mount Panorama. The valley is flat and shallow, covered by a thick deposit of white sand which forms the bed of Peters' Creek, on the one side, and a heavy sandy road on the other. The valley was followed as far as the Knott's Hill school-house but was not traced further. It is probable that the Meadows Creek has captured the upper portions of Peters' Creek.

These ancient fluviatile deposits can be traced in a further westerly direction through the Hundred of Willunga, where, in several places they are found resting

on fossiliferous Miocene beds. A well sunk by Mr. F. G. Scammell in the south-eastern corner of Section 11 (situated about two and a half miles to the westward of Wickham's Hill) gave the following record:—Sandy loam, 2 feet; stiff reddish-yellow clay, 8 feet; gravel, 21 feet; fine sand, 33 feet; soft sandstone with iron-stone bands, 12 feet. This gives a thickness of 76 feet of alluvium; below which was Miocene fossiliferous sandstone, 14 feet. [Govt. Geol. Ann. Rep., 1914 (1915), p. 9].

The district road that crosses the line near the McLaren Vale railway station rises to the hill on its northern side. About 30 feet above the level of the railway a bed of fossiliferous Miocene crosses the road. The fossils, which are chiefly in casts, are of common and characteristic species. In going up to the next rise, towards Sea-View, a cutting in the road shows the alluvial beds resting on a friable outcrop of glauconitic clay, also of Miocene age. The hill, which is about 150 feet above the level of the valley, is capped with beds of sand, gravel and ferruginously cemented conglomerate.

The River Onkaparinga supplies an interesting physiographical study. Next to the River Murray it is the most ancient of South Australian rivers and may be classed as an antecedent river, having been contemporaneous with some of the later stages in the great geographical revolution that brought to a close an older hydrographical system and initiated a new one. In this deformation, that proved fatal to most of the original river systems of South Australia, The Onkaparinga, like The Murray, has kept its way open to the seaboard. Its origin can be definitely fixed as Post-Miocene, as its original channel was excavated in the raised sea-bed of that period. The tectonic movements that raised the Mount Lofty Ranges and brought about great block-faulting (under which the Mount Lofty segment was pitched down to the base of the Willunga fault scarp) may have created the conditions favourable for its origin, the faulting having brought into existence a sunk-land that became a natural channel for the local drainage. This may be considered as the initiatory stage in the river's existence. [See 6, p. 53-59.]

A second stage was reached, when by base-levelling, slow sinking of the earth's crust, and loss of grade, the river aggraded its bed, overspread its banks on the northern side, carrying with it its alluvia which, in the deeper channels, reached a thickness of at least 300 feet. The river had now reached its maturity; largely blocked by its own sediments, it spread its waters over a wide flood-plain, in a meandering course, by lateral erosion. At this stage its delta-like channels had a width of ten miles, extending from Sellick's Hill, in the south, to Noarlunga in the north, possibly making a junction with the Hope Valley-Blackwood river (if they synchronized in age) in its lower stretches. [See ante, p. 35.]

A third stage was initiated by a reversal of earth movements, from a negative to a positive development, causing an increase of grade that gave rejuvenated energy to the stream. At this juncture the old-time Onkaparinga happened to have had its course near the northern limits of its valley, and in that situation began to erode its own sediments, reaching bed-rock. The ditch thus created restricted the river to a definite narrow channel, which marks its rejuvenation stage and fixed its topographical features; following a serpentine course, and from being a base-level stream it became an entrenched meander, as it is in the present day. Collateral evidences of the relatively recent age of the present channel of The Onkaparinga are seen in the fresh condition of the Purple Slates over which it flows in its lower portions, as compared with the rotten and kaolinized condition of the slates that are seen in the deserted channels of the extinct rivers. This development of a higher grade throughout the region, incidental to the process of elevation, also had its influence on the upper reaches of the river which, under the rejuvenation stimulus, also incised their channels, creating secondary valleys within the main valley.

A fourth stage in the history of The Onkaparinga is seen in the partial re-excavation of the deserted valley that lies to the southward of the present outlet of the river, extending from near Mount Bold to the present sea coast. No streams of importance exist in this wide valley today. The residual sediments of the former river course absorb all the drainage that comes from the Willunga Ranges, while a few minor streams originate near the coast, and these have had only a modern existence. [See "Story of Aldinga," "The Chronicle," No. 3,994, June 1, 1933, p. 46.] It is probable that the excavation of the deserted river valley may have been accomplished, chiefly, during the period of cooler temperatures and greater rainfall in South Australia which immediately preceded modern times.

There is a certain chronological relationship between the River Murray and The Onkaparinga, inasmuch as their respective origins date back to the antecedent, main hydrographic systems of the country and from their being the only rivers of those ancient systems that have maintained their outlet to the sea in South Australia during the subsequent physiographical changes. There are clear evidences that The Murray formerly reached the sea through the present Wimmera district of Victoria. The elevation of the south-eastern portions of South Australia, amounting to 250 feet, within Pleistocene and Recent times gradually forced The Murray channel in a westerly direction until arrested by the highlands of South Australia. The geological history of this great river has been dealt with by the writer in a paper, "Notes on the Geology of the Great Pyap Bend (Loxton), River Murray Basin, and Remarks on the Geological History of the River Murray" [Trans. Roy. Soc. S. Aust., vol. liii., 1929, pp. 167-195, pls. vi.-viii.].

V. CORRELATION AND AGE OF THE BEDS.

The late Professor Ralph Tate noted the occurrence of consolidated alluvia in some places in South Australia, which he defined as "Upland Miocene"; but he offered no explanation of their occurrence, and incorporated under the same terms formations that were of widely different geological ages.

Some of the features pertaining to these beds, if met with in Central Australia, would be classed as Desert Sandstone, and it is not improbable that some of the beds, so called, might be synchronized with the remains of rivers, once active but now extinct, in the southern portions of their courses.

Several geological observers have recognised the existence of certain "high-level, flat-topped alluvial deposits" in Central Australia, more or less consolidated by interstitial cement, often carrying silicified wood. Madigan (14) has referred these older alluvial deposits of the interior to a special class that he names the Arltungan Beds. Among the localities mentioned were the Todd, Paddy's Hole, Hale, and Plenty Plains. The author quoted states *(loc. cit.*, p. 97*)*: "They had every appearance of being remnants of an older filling of the same valley plains in which they now lie. One such was described from the western region, in the plain, in the middle of the Waterhouse Range, where coarse gravel contained large silicified tree trunks . . . On the Plenty Plain, the flat-topped remnants are much bigger and more conspicuous, standing out as small tablelands or mesas." One of these described had "a flat-top that stood about 90 feet above the plain. The bottom 50 feet was grey sandy clay, overlain by 15 feet of red ferruginous sandstone, and capped by 25 feet of white chalcedony, the thickest of such cappings observed." The resemblances of these Arltungan beds to similar remains found in the dry river channels of South Australia, is suggestive of a probable correlation of the two as to age as well as a direct physiographical relationship in a former larger hydrographical system.

The geological history of these old sands and conglomerates is of absorbing interest, for they have shared in one of the greatest geological revolutions that

has happened in the southern portions of Australia. When were these dry river channels, many hundreds of miles in length, the beds of refreshing streams? If they were fed by streams from the Far North the present physical barriers could not at that time have had any existence, so that their active stage must have antedated the elevation of the Mount Lofty Ranges, and, therefore, antecedent to what E. C. Andrews has called "The Kosciusko Epoch," a period that may be referred to a geological stage within either late Pliocene or early Pleistocene times.

An important datum, in fixing the age of these beds, is their definite Post-Miocene occurrence. At Happy Valley, Morphett Vale, Hackham, and McLaren Vale the ancient channels intersect and overlie the marine deposits of the Miocene period. Another datum bearing on the age of this line of ancient drainage is available. The bed of the extinct river in the neighbourhood of Adelaide rests on the highest of the shelvings caused by the step-faulting of the western scarp of the ranges, forming the foothills in the line of Hope Valley, Belair, and Blackwood, having an elevation of from 600 feet to 1,000 feet above sea level. No important river could occupy such a position with the present configuration of the country. We must assume that at the time of the river's existence it had, approximately, reached the base-level of the river system, which was before the major tectonic movements occurred that caused the great trough-fault of the gulfs, and transformed the river system, by a change of grade, from a north and south to an east and west direction.

At a later date, when the older rivers had ceased to carry their burdens to the sea, an intensification of the trough-fault caused further step-faulting along the slopes of the ranges, when a segment of the foothills was faulted down, over 700 feet, carrying the old river sediments with it. This happened subsequently to the truncation of the older drainage system, but before the earth settlements, near Adelaide, had reached their maxima.

There are two fossiliferous Pliocene horizons (an older and a newer) in the neighbourhood of Adelaide, but neither of them is found in stratigraphical relationship with the extinct river basin. The evidences seem to favour the view that the encroachments of the sea, that laid down at least the newer of these deposits, occurred subsequently to the truncation of the older river systems. A better acquaintance with the palaeontology of these so-named Pliocene beds may lead to their being placed, chronologically, at higher geological horizons.

Conclusion.

The present attempt to determine the effects produced by the elevation of the Mount Lofty Ranges on the older river systems of the country and the delimitation of the main river channels of these ancient systems must be regarded, to a certain extent, as tentative. The country concerned is very extensive; the time involved in the tectonic revolution, considerable; the evidences are superficial, and more or less evanescent under the meteorological conditions to which they have been exposed; and further, the disturbing influence of a superimposed system of drainage which intercepts and to some extent has rearranged the material of the older systems of drainage, all tend to obscure the question.

On the other hand, the facts are so clear and consistent, over hundreds of miles of lineal deposits, that the general principles involved seem to be beyond question. Some local adjustments may be required as to the routes followed by the trunk lines, and by detailed observations more tributaries may be added to complete the respective river systems as they once existed.

The older physiography illustrates the amplitude of the freshwater resources that formerly distributed their life-giving streams, not only over the coastal regions of the continent, but, also, over much of what is now the arid interior.

It is perhaps necessary to state, that as the observations recorded in these two papers have ranged over more than 30 years, certain local names and references may be found out of date, and as a warning the date of observation has in some cases been included in the text.

BIBLIOGRAPHICAL REFERENCES.

(1) East, J. J., 1886—Geological Section from the Head of St. Vincent Gulf, eastward across the Wakefield and Light River Basins. Trans. Roy. Soc. S. Aust., vol. viii., pp. 1-9, pl. i.

(2) Brown, H. Y. L., 1889—Geological Map of the Tertiary Deposits of the Hundred of Barossa with Explanatory Notes. Govt. Printer, Adelaide, No. 29.

(3) Woodward, H. P., 1885—Geological Map of the Barossa and Western Portion of the Para Wirra Gold Field Reserve. Govt. Printer, Adelaide, No. 178.

(4) ————, 1886—Geological Map of the Eastern Reserved Portion of the Hundred of Para Wirra, known as the Mount Crawford and Gumeracha Diggings, and Reserved Section in the north of Talunga. Govt. Printer, Adelaide, No. 62.

(5) Scoular, G., 1878-9—Geology of the Hundred of Munno Para. Trans. Phil. Soc. of Adelaide (Roy. Soc. S. Aust.), pp. 60-70.

(6) Howchin, W., 1911—Description of a Disturbed Area of Cainozoic Rocks in South Australia, with Remarks on its Geological Significance. Trans. Roy. Soc. S. Aust., vol. xxxv., pp. 47-59, pls. x.-xix.

(7) ————, 1927—Sturtian Tillite in the Neighbourhood of Eden, etc. Trans. Roy. Soc. S. Aust., vol. li., pp. 330-349, pls. xiv.-xv.

(8) ————, 1929. Notes on the Geology of the Great Pyap Bend (Loxton), River Murray Basin and Remarks on the Geological History of River Murray. Trans. Roy. Soc. S. Aust., vol. liii., pp. 167-195, pls. vi.-viii.

(9) Tepper, J. G. O., 1888—Notes on the Surface Features and Rocks of Nuriootpa and its Neighbourhood. Trans. Roy. Soc. S. Aust., vol. xi., pp. 25-29.

(10) Department of Mines, 1911—Review of Mining Operations. No. 14.

(11) ———————— 1914 Do. Do. No. 20.

(12) ———————— 1921 Do. Do. No. 33.

(13) Basedow, H., 1904—Notes on Tertiary Exposures in the Happy Valley District. Trans. Roy. Soc. S. Aust., vol. xxviii., pp. 248-252, pls. xxxv.-xxxvi.

(14) Madigan, C. T., 1932—The Geology of the Eastern MacDonnell Ranges, Central Australia. Trans. Roy. Soc. S. Aust., vol. lvi., pp. 71-117, pls. iii.-v.

DESCRIPTION OF PLATES.

Plate I.

Fig. 1. Ancient Consolidated Gravels forming a plateau in the ridge between the Hutt and Hill Rivers. Escarpment facing east. Hundred of Milne, Section 571. Photo, Prof. W. Howchin.

Fig. 2. Ancient Consolidated Gravels. Same site as in Fig. 1; showing bird's-eye view of the surface of the plateau. Photo, Prof. W. Howchin.

Plate II.

Fig. 1. Ancient River Plateau on the western side of Stockport, showing escarpment facing east. Photo, Prof. W. Howchin.

Fig. 2. High-level Ancient River Terrace of Consolidated Gravel; east side of Stockport, 200 feet above the site shown in Fig. 1. Photograph taken from near base of hill. Photo, Prof. W. Howchin.

Fig. 3. The same as shown in Fig. 2, in near view. Photo, Prof. W. Howchin.

Plate III.

Fig 1. Escarpment of Ancient River Terrace, 80 feet, situated on the eastern side of Hope Valley, near Anstey's Hill. Photo, Prof. W. Howchin.

Fig. 2. Section of Old Consolidated Alluvium resting unconformably on decomposed slates. Back of Blackwood railway station. Photo, Prof. W. Howchin.

Plate IV.

Fig. 1. Ancient Alluvial Sand-rock, exposed in railway cutting near Morphett Vale. Photo, Prof. W. Howchin.

Fig. 2. Railway cutting, near Hackham, showing Ancient Gravels resting unconformably on fossiliferous Miocene beds. The line of junction is shown by the position of the hammer. Photo, Prof. W. Howchin.

INFLAMMABLE GASES OCCLUDED IN THE PRE-PALAEOZOIC ROCKS OF SOUTH AUSTRALIA.

By L. Keith Ward, B.A., B.E., D.Sc.

[Read April 13, 1933.]

I. OCCURRENCE AND COMPOSITION.

In the latter part of 1921 a borehole was drilled by the American Beach (K.I.) Oil Coy., N.L., in search of petroleum at a place selected by the divining rod, 7 miles to the south-west of Penneshaw (Hog Bay), Kangaroo Island.

After passing through 135 feet of the older sand-dune formation, probably of Pleistocene age and consisting of calcareous and siliceous sands, the drill entered a thick bed of bluish clay, possibly of Tertiary age, containing no boulders and extending to a depth of 292 feet from the surface. Beneath the clay the drill penetrated mica-schist, phyllite and quartz-mica-schist. The borehole was visited when the total depth was 307 feet, and in the face of strong advice to the contrary, the Company decided to continue boring. Misfortune met the driller, who lost the sinker bar and drill attached at 366 feet. The Company had arranged for a deep hole and insisted on the fulfilment of the contract. A new hole was, therefore, drilled at a site only 4 feet from the first hole, so that the "stream of oil" might not be missed.

In July, 1922, inflammable gas was reported from the borehole, and extraordinary statements were made regarding a ball of fire travelling backwards and forwards between the bore site and the sea. The Company was urged to obtain samples of the gas, and the method of collection from the bailer was explained. Samples were collected and analysed by the Government Analyst, at a time when a depth of 615 feet had been reached. Boring was continued and more gas was reported, a further sample, obtained from 950 feet, being submitted to the Works Chemist of the South Australian Gas Works. The details of these analyses are as follows:—

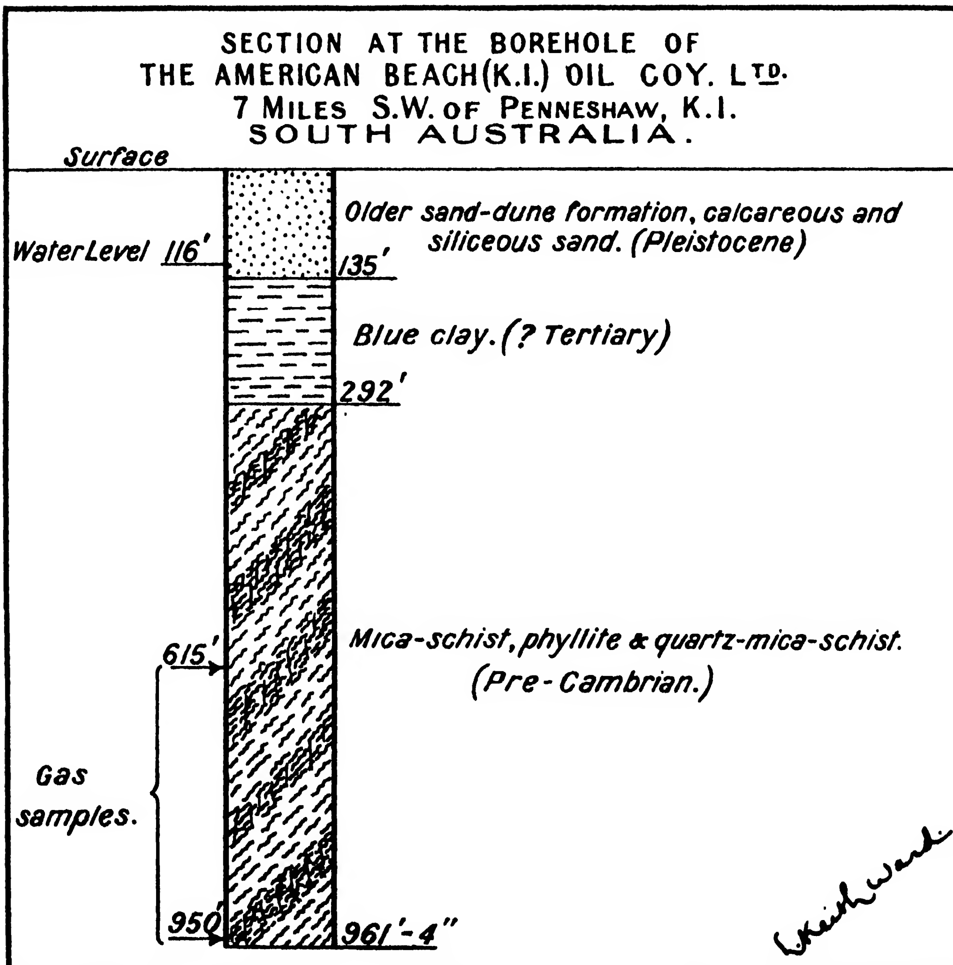
	I.	II.
Depth of borehole	615 ft.	950 ft.
Analyst	W. A. Hargreaves	N. L. Woore
Carbon dioxide	5·3%	0·52%
Oxygen	4·3%	3·55%
Ethylene, etc.	0·5%	Nil
Carbon monoxide	Nil	Nil
Hydrogen	51·3%	68.64·%
Methane	2·6%	4·68%
Nitrogen (by difference)	36·0%	22·61%
Total	100%	100%

Boring operations ceased when a total depth of 961 feet 4 inches was reached, and have not been resumed. Water level in this borehole was at a depth of 116 feet from the surface.

More recently, in 1931, a borehole was started at a place 6½ miles to the east of Minlaton, on Yorke Peninsula, where the Permo-Carboniferous tillite has been removed by erosion from the Cambrian archaeocyathinae limestone. This site also was selected by diviners. The hole is now 1,800 feet deep, and may be deepened. Splendid samples have been kept at all stages of this work, and have

been submitted for examination. The following condensed section is based on these samples:—

Surface to 253 ft.	.	Cambrian limestone with Archaeocyathinae.
253 ft. „ 292 ft.	....	Basal Cambrian shale, sandstone and grit.
292 ft. „ 548 ft.	. .	Upper Pre-Cambrian limestone with some phyllite and calcareous and siliceous slate.
548 ft. „ 855 ft.	.	Upper Pre-Cambrian crystalline limestone.
855 ft. „ 1,800 ft.		Upper Pre-Cambrian light and dark grey limestone.



The Cambrian beds appear to be horizontal or nearly so, but the attitude of the subjacent limestone is unknown. Water level stands at 160 feet below the surface in this borehole.

Inflammable gas was first observed in the sludge raised in the bailer when a depth of 370 feet had been reached. Samples were not recovered till the hole was 790 feet deep, and further samples were taken by Mr. R. W. Segnit and the writer when the depth was 860 feet. Another sample was taken by the driller when the bottom of the hole was 1,666 feet below the surface. All these samples have been

analysed by the Government Analyst, with the results shown in the following table:—

	I.	II.	III.	IV.	V.	VI.
Depth from surface	790 ft.	790 ft.	860 ft.	860 ft.	860 ft.	1,666 ft.
Carbon dioxide ..	0·8%	0·2%	0·8%	0·8%	0·6%	Nil
Oxygen	Nil	Nil	3·2%	2·4%	3·0%	1·2%
Ethylene, etc. ..	Nil	Nil	Nil	Nil	Nil	Nil
Carbon monoxide .	Nil	Nil	Nil	Nil	Nil	Nil
Hydrogen	74·0%	76·0%	60·0%	64·4%	60·0%	84·0%
Methane	7·5%	7·5%	5·4%	7·0%	5·6%	Nil
Nitrogen (by difference)	17·7%	16·3%	30·6%	25·4%	30·8%	14·8%
	100%	100%	100%	100%	100%	100%

In neither case, at Kangaroo Island or near Minlaton, has it been possible to estimate the quantity of the gas liberated. Drilling was done in each case by a percussion plant. Water level is far below the surface, and it is not possible to say whether there is any appreciable amount of gas rising through the deep column of water in the borehole. The gas was seen bubbling out of the sludge after its discharge from the bailer, and could be seen escaping from the top of the bailer when it is raised from the bottom of the hole to the surface.

It would appear that the pressure of the water column facilitates the solution of the gas as it is liberated from the rock pounded up by the drill, and that on the diminution of this pressure (by the raising of the bailer to the surface) the gas in solution bubbles off.

It does appear, moreover, that the amount of gas set free and taken into solution is variable in different parts of the same formation. It has been found, when efforts have been made to collect samples, that it is sometimes easy to fill a quart bottle from a single bailer, and that on other occasions several bailers must be raised to the surface in order to get a single bottleful of gas.

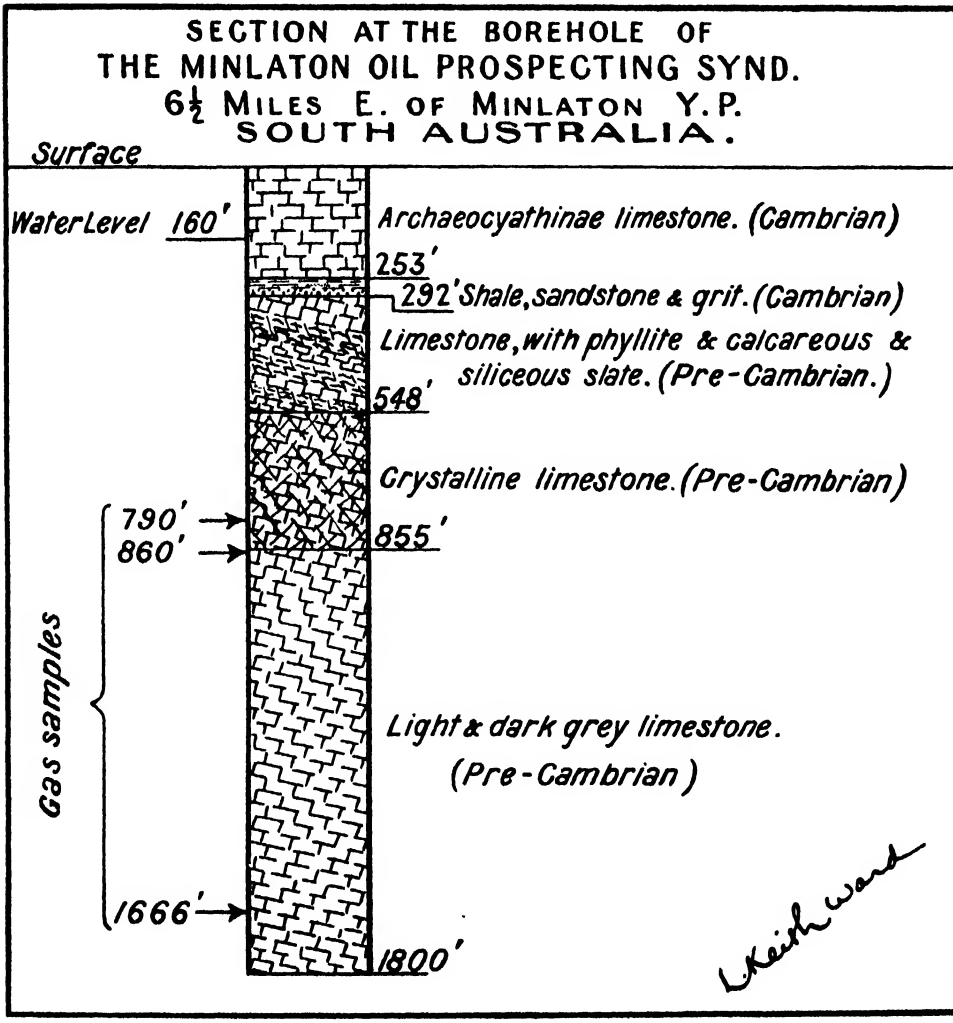
II. ORIGIN OF THE GASES.

A cursory glance at the composition of these gases shows that they are entirely distinct from the "natural gas" that is associated with many occurrences of petroleum, from the "fire damp" that is liberated from coal seams, and from the "marsh gas" derived from the decomposition of vegetation under wet conditions that prevent oxidation by the atmosphere.

Yet the kind of gas obtained in these boreholes has been found before in the systematic examination of rocks and meteorites for the nature and amount of their gas content. The classic work is that of Professor R. T. Chamberlin, of Chicago, whose study of "The Gases in Rocks" was published in 1908 by the Carnegie Institution, of Washington, as one of the series of contributions to cosmogony and the fundamental problems of geology. A summary of the work of many investigators will be found on pages 276 to 288 of the fifth edition of "The Data of Geochemistry," by F. W. Clarke, published as Bulletin 770 of the United States Geological Survey.

The essential point of difference between the gases obtained by Wright, Tilden, Travers, Gautier, Chamberlin, and Brun from various rocks and those concerned in this paper, lies in the fact that the investigators named recovered their samples from specimens heated to redness in vacuo, whereas the gas samples here mentioned were obtained by the mere pounding up of the unheated rocks during drilling.

Both Gautier and Chamberlin attribute the greater part of the gases to reactions within the rocks themselves, brought about by heat; but recognise that there are gases in some minerals like beryl that must have an origin outside the mineral host, which does not carry enough water and iron to give the amounts of hydrogen present. Chamberlin regards the water giving rise to the hydrogen as derived largely from the micas of the deep-seated rocks, that is to say of magmatic origin. He proved by numerous analyses that the gases in rocks consist of H_2S, CO_2, CH_4, H_2, and N_2, but that chlorine and its compounds are absent. The



ferromagnesian rocks carried the most gas, and in general hydrogen and the oxides of carbon predominated. Chamberlin found, also, that H_2 and CO_2 are about equally important in deep-seated rocks, but that CO_2 predominated in surface flows. So far as age is concerned the oldest rocks contained the most gas, and recent lavas gave much less than Archaean plutonic types. One noteworthy feature of Chamberlin's work was his neglect of the carbonates—limestones and dolomites—doubtless because of the probable obliteration of other gases by the CO_2 that would be set free by his method of treatment.

Commenting on the results of the analyses of the South Australian gases, one would be inclined to note particularly:—

(a) The presence of methane in notable proportions in highly altered and apparently non-carbonaceous rock types. The possible origin is mentioned below in paragraph (c).

(b) There is an obvious source of carbon in a limestone, but not in the case of mica-schist, phyllite or quartz-mica-schist, unless there is present some small but unnoticed proportion of a carbonate mineral.

(c) The presence of methane and hydrogen looks strange in the presence of carbon dioxide and the complete absence of carbon monoxide. The presence of a powerful reducing agent would lead one to expect the reverse position, unless there has been some such reaction as Gautier claimed to have induced at high temperatures. He gave the following equations:—

At 900° to 1,000° .. $4CO + 2H_2 = 2H_2O + CO_2 + 3C.$

At 1,200° to 1,220° . $4CO + 8H_2 = 2H_2O + CO_2 + 3CH_4.$

(d) No organic matter has been observed in the old limestones at Minlaton, although there are organic remains in the overlying Cambrian limestone.

The occurrences being such puzzling ones for which to provide a satisfactory explanation, Professor R. T. Chamberlin has been consulted and has been good enough to write several times on the subject. He drew attention to the fact that the case is essentially different from the situation obtained in his experimental work, in that he heated the rock material and that the bulk of the gas obtained was undoubtedly the result of reactions which took place at the temperatures used by him. But he stated further that he was able to show that a proportion of the gases, in some cases at least, was already present in the rock in the gaseous condition. Professor Chamberlin's later communication (June 24, 1932) deals with the origin of the constituents of the gas in the following words:—

"The methane would seem to me to be probably of organic origin, even though coming from a quartz-mica-schist. I am assuming that this rock was originally a sediment containing organic matter, and that in the processes of consolidation, metamorphism, etc., decomposition of this matter gave rise to methane and that gas thus far has not been able to escape, or in any case a considerable amount of it still remains in the rock. Carbon dioxide has probably also come from the same process; hydrogen might also, if during metamorphism the temperature became sufficiently high. Hydrogen, of course, may also have come in from some action below. That carbon dioxide has not been reduced to the monoxide seems to me to indicate that the temperature has never been sufficiently high to cause this reduction.

"Such results as I obtained are inherently involved in volcanic and other high temperature phenomena, and hence their importance in those fields. There being no carbon monoxide in the gas upon which you report, whereas methane is particularly high, it seems to me that the set-up is different, and the gases primarily have resulted from low-temperature reactions probably in large part involving organic material. I think that, if this difference be kept clearly in mind, you will find the results not inharmonious.

"I know that there are various occurrences of methane and carbon dioxide, with perhaps minor amounts of hydrogen also, where the source is presumably the decomposition of organic material. The Dexter gas well in Kansas and various other occurrences in unmetamorphosed Palaeozoic rocks are illustrations. Apparently in your case the peculiarity is the gas coming from intensely metamorphosed rock, but, after all, if that were originally a sediment, and much of the gas could not escape, the results would be somewhat like what you have."

In an earlier letter (March 23, 1932) Professor Chamberlin had stated:—

"In some potash mine near Stassfurt there are blowers of gas of which hydrogen composes 93%. A possible explanation of this might be the reaction between water and ferrous compounds which goes on when the temperature is raised sufficiently. I am wondering whether in the process of metamorphism which developed the slates and phyllites, the temperature might have been raised 100° or 200°, which caused some reaction between water and ferrous compounds. At the same time, a slight rise in temperature would break up organic matter, giving rise to methane. Some of these gases would then remain within the rocks until tapped by boring."

In granting permission for the publication of these quotations from his letters, Professor Chamberlin, on December 15, 1932, made further suggestions in the following terms:—

"The only later suggestion which occurs to me is the possibility that all the gas has not come from the same source. The presence of methane and ethylene seems to me to suggest organic origin, but the high proportion of hydrogen rather suggests that it has come from inorganic sources. So as a wild guess the methane has come from ancient sediments, whereas the hydrogen may have come from a magmatic source or from a high-temperature chemical reaction between ferrous iron and water.

"It would seem to me possible for the hydrogen to have moved upward and to have become mixed with the methane somewhat closer to the surface. This is highly speculative, but after all it seems to me not impossible. If so, there probably was not much carbonate or carbon dioxide involved in the lower depth, otherwise I should be inclined to expect carbon monoxide in the gases. Of course, some carbon dioxide could be taken up in carbonation of rock materials, and hence the small amount found."

Before leaving the subject, it should be remarked that no examination has been made of the residual nitrogen to ascertain whether helium is present. There are no data, therefore, for the consideration of a radio-active origin for any of the gas.

If we are right in assuming an organic origin for some at least of the gas, the interesting question arises as to the possibility of the survival of this gaseous matter in the occluded state in rocks that have lost by metamorphism all other traces of their organic content.

These facts of occurrence and composition, and these questions of origin are brought forward in the hope that others may assist to clear up a rather puzzling mystery that shows already signs of wide distribution in space and perhaps in time. One cannot expect that similar phenomena will be observed where the hole is a dry one, or where an artesian flow exists to carry off the gas as fast as it is liberated from the rock broken up by the drill. But it seems reasonable to expect that other similar occurrences will be noted by observant drillers where a considerable depth of water stands in the holes, if they watch carefully for effervescence in the water and sludge raised to the surface.

A PRELIMINARY ACCOUNT OF THE COLLEMBOLA-ARTHROPLEONA OF AUSTRALIA.

By H. Womersley, A.L.S., F.R.E.S. (Entomologist, South Australian Museum).

PART I.—SUPERFAMILY PODUROIDEA.

[Read June 8, 1933.]

That the Collembola as a whole, and this superfamily in particular, has received very little attention from entomologists in Australia is doubtlessly due to their small size and to the supposed lack of economic importance.

Most of the species recorded and described in this paper were collected by the writer while working in Western Australia as an officer of the Commonwealth Council for Scientific and Industrial Research.

In addition, very great help and encouragement have been received from Dr. R. J. Tillyard and other friends who have collected material in other States and forwarded it for identification and study. To all these the writer tenders his deepest thanks. All such records are acknowledged by placing the collector's initials after the particular record.

Three species of this superfamily were described in 1899 by Sir J. Lubbock as from Tasmania (168). His names for these were *Anoura tasmaniae, A. dendyi,* and *A. spinosa.* In 1906, Börner placed the last two species in new genera and left the first in the genus *Achorutes* Temp., which had replaced *Anoura.* Börner's names for the first two species were *Acanthanura dendyi* and *Holacanthella spinosa* (38). In 1925, Dr. G. H. Carpenter (Mem. & Proc. Manchester Lit. and Phil. Soc., vol. lxix.), while describing some Collembola from New Zealand showed that Lubbock's species had been erroneously recorded from Tasmania, and that they had been found in New Zealand.

The first authentic record, then, of species of Collembola belonging to this superfamily occurring in Australia would appear to be that of J. W. Rainbow (198) in 1907. In that paper the author described two new species, *Achorutes speciosus* and *Isotoma troglodytica,* from New South Wales. Through the courtesy of the Curator of the Australian Museum at Sydney, the writer has been able to examine the type slides of Rainbow's material, and it is now shown that these two species are synonymous with earlier known European species, namely *Xenylla mucronata* Axelson and *Proisotoma minuta* (Tullberg). The second species belongs to the superfamily Entomobryoidea, and will be dealt with in a later paper.

In 1917, Schött (226), in his paper on the Collembola collected in Australia by the Mjöberg Swedish Expedition of 1910-13, recorded only the following five species:—*Hypogastrura armata* (Nicolet), *Pseudachorutes incertus* Schött, *Ceratrimeria maxima* (Schött), *Achorutes rosaceus* Schött, *Achorutes cirratus* Schött.

In this paper further records are given for four of Schött's species as well as *Xenylla mucronata;* in addition 24 species are added to the list, making a total of 30 species of Poduroidea now known to occur in Australia. The full list is as follows:—**Hypogastrura armata* (Nicolet); **H. manubrialis* (Tullberg); **H. manubrialis* var. *neglectus* Börner; **H. purpurascens* (Lubb.); **H. pseudopurpurascens* Womersley; **Xenylla maritima* Tullberg; **X. grisea* Axelson; *X. littoralis,* n. sp; *X. occidentalis,* n. sp.; **X. mucronata* Axelson; **Friesia mirabilis* (Tullberg); *Ceratrimeria maxima* (Schött); **Odontella lamellifera*

(Axelson); *Pseudachorutes incertus* Schött; **P. rhaeticus* (Carl); **Brachystomella parvula* (Schäffer); *B. fungicola*, n. sp.; *B. afurcata*, n. sp.; *B. acantha*, n. sp.; *B. anomala*, n. sp.; **Anurida granaria* (Nicolet); *Neachorutes glauerti*, n. gen., n. sp.; *Achorutes rosaceus* Schött; *A. cirratus* Schött; *A. hirtellus* Börner; *A. newmani*, n. sp.; **Onychiurus fimetarius* (Linn., Lubbock); **O. ambulans* (Linn., Tullberg); **O. armatus* Tullberg; *Tullbergia trisetosa* (Schäffer); *T. australis*, n. sp. Of this number nine species and one genus are new to science, and no fewer than 15 species and one variety are well-known European forms. The latter are marked by an asterisk.

Economic Importance of the Poduroidea.

Although considerable attention is being focussed on the economic importance of certain Collembola belonging to the family Sminthuridae, little notice appears to have been taken of the species discussed in this paper.

The attention of economic entomologists was first directed to the Collembola by Dr. G. H. Carpenter (68) in 1905, when he recorded *Hypogastrura (Achorutes) armata* (Nicolet) and *Onychiurus (Lipura) ambulans* (Linn., Lubbock) as attacking bean seeds, and *H. (A.) armata* and *H. (A.) longispina* (Tullberg) as occurring on fruit lying on the ground.

In 1911, before the First International Congress of Entomology, held at Brussels, F. V. Theobald (241) surveyed the recorded instances of damage due to species of Collembola. He enumerated 23 species, of which 20 are at present regarded as valid, the remainder being synonyms. Representatives of the Poduroidea in Theobald's list number eight, five of which occur in Australia. These species are:—*Hypogastrura (Achorutes) armata* (Nicolet), *H. (A.) manubrialis* (Tullberg), *H. (A.) longispina* (Tullberg), *H. (A.) purpurascens* (Lubbock), *H. (A.) rufescens* (Nicolet), *Onychiurus (Lipura) armata* (Tullberg), *O. (L.) ambulans* (Linn., Tullberg), *O. (L.) fimetarius* (Linn., Lubbock), *Kalaphorura (Lipura) burmeisteri* (Lubbock).

In addition he gave the following personal observations of damage by these small insects:—1. *H. (A.) purpurascens* (Lubbock) on cabbages; 2. *H. (A.) rufescens* (Nicolet) damaging mushrooms; 3. *O. (L.) ambulans* (Linn., Tullberg) attacking celery, cauliflower, sea kale and asparagus; 4. *O. (L.) fimetarius* (Linn. Lubbock) attacking strawberry plants.

In 1906 W. E. Collinge (82) recorded *O. (L.) ambulans* on bulbs damaged by eel-worm, and *H. (A.) armata* from nursery gardens in Birmingham, England In his "Manual of Injurious Insects" (82) the same author proves that Collembola are often the primary cause of injury to orchids, bulbs, beans, peas, and fruit trees, the resultant injuries allowing the access of fungal spores, thus leading to subsequent decomposition of the plant tissues. Recently three species of *Onychiurus* have been described from Japan by J. Matsumota and T. Satto (177) as occurring on and damaging wheat.

Apart from feeding on foliage and decaying organic matter, the members of this superfamily of Collembola are often found inhabiting the gills of various fungi, and in microscopic mounts the intestines are often found to contain fungal spores. From this it follows that even if the initial damage caused by these insects is not of itself great, yet they may readily be the cause of more serious and extensive harm.

In addition, while many of the species are essentially soil feeders, they will also attack the young roots and rootlets of plants. If present in large numbers, as they often are, this may lead to serious harm and even death of the plants.

On the other hand, at least one species, *Hypogastrura viatica* (Tullberg) has been shown to be of considerable industrial use (29). It can be used to clean automatically the top of sewage filter beds from the growths of algae, which other-

wise interfere with the proper working and necessitate periodical stoppage for its removal.

While the recorded cases of damage by this group of Collembola may be considered as slight, it must always be kept in mind that those species which are now shown to occur in Australia, probably as introductions, may, under the more suitable climatic conditions, become major pests and cause extensive and widespread damage as in the case of the Clover Springtail.

Collembola-Arthropleona Börner, 1901.

This suborder of the Collembola, which comprises all those forms with elongate bodies, has been divided by Börner (44) into two superfamilies which he calls Entomobryomorpha and Poduromorpha. As these names are decidedly cumbersome, it would seem better to follow the suggestion of Dr. R. J. Tillyard and adopt the customary superfamily ending "oidea."

The two families are separated thus:—

1. (2) Prothorax free, similar to the other thoracic segments, furnished with hairs, not hidden under mesothorax. Cuticle mostly granular, in some cases with pseudocelli. Antennae short, 4-segmented.
Superfamily Poduroidea
= Poduromorpha Börner, 1913

2. (1) Prothorax not haired, more or less hidden under mesothorax. Cuticle smooth, haired or scaled. Antennae long, 4-6-segmented.
Superfamily Entomobryoidea
= Entomobryomorpha Börner, 1913

Superfamily PODUROIDEA.

Family HYPOGASTRURIDAE Börner, 1913.

Syn.=*Achorutini* Börner, 1901 (ad partem); *Achorutinae* Börner, 1901 (ad partem); *Hypogastrurinae* Börner, 1906.

Genus Hypogastrura Bourlet, 1839; Börner, 1906.

Syn.=*Podura* Linne, 1746 (ad partem); *Achorutes* Templeton, 1835 (ad partem); *Hypogastrura* Bourlet, 1839; *Achorutes* Tullberg, 1872; *Schöttella* Schäffer, 1896.

Subgenus Hypogastrura s. str. Börner, 1906; Linnaniemi, 1912.

Syn.=*Achorutes* Schäffer, 1896 (ad partem); *Achorutes* Börner, 1901 (ad partem); *Hypogastrura* s. str. Börner, 1906 (ad partem).

Hypogastrura armata (Nicolet).

(Text fig. 1, *a-c.*)

Podura armata Nicolet, 1841; *Achorutes armatus* Tullberg, 1871; *Achorutes boletivorus* Packard, 1873; *Achorutes texensis* Packard, 1873; *Achorutes pratorum* Packard, 1873; *Achorutes marmoratus* Packard, 1873; *Achorutes filiformis* Wahlgren, 1906; *Hypogastrura armata* (Axelson) Linnaniemi, 1911.

Description—Length, 1·5-2·0 mm., with moderately long dorsal setae, often serrated. Ocelli, eight on each side on black patches. Postantennal organ with four unequal peripheral lobes. Antennae shorter than head. An exsertile sac between third and fourth antennal segments. Fourth antennal segment with 7 olfactory hairs and an apical knob. Claws slender, with inner tooth near the middle and a lateral outer tooth. Empodial appendage with basal lamella and

apical spine which often reaches tip of claw. One long tibio-tarsal hair present, which is not clavate. Dens twice as long as mucro. Mucro apically rounded, outer lamella with deep incision and tooth-like lobe. Anal spines longer than

Fig. 1.

a. *Hypogastrura armata* (Nicolet). Claw and tip of tibiotarsus.
b. „ „ „ Mucro from side.
c. „ „ „ Antennae III. and IV.
d. „ *manubrialis* (Tullberg). Mucro and dens from side.
e. „ „ „ Claw and tip of tibiotarsus.
f. „ *pseudopurpurascens* Womersley. Claw and tip of tibiotarsus.
g. *Xenylla maritima* Tullberg. Furca from side.
h. „ „ „ Anal segment.
i. „ *grisea* Axelson. Antennae IV. and apex of III.
j. „ „ „ Anal segment from above.
k. „ „ „ Furca from side.

11641

claws, narrow, curved and placed on papillae which touch at their base. Colour variable, from brownish to blackish.

Three varieties of this species are recognised and can be separated by the following key:—

1. (4) Anal spines present.
2. (3) Bristle of empodial appendage reaching beyond tip of claw and apically bent.—*H. armata* var. *cuspidata* Axelson.
3. (2) Bristle of empodial appendage straight and only reaching tip of claw.—*H. armata* (Nicolet) *forma principalis*.
4. (1) Anal spines absent.—*H. armata* var. *inermis* Axelson.

This almost cosmopolitan species was first recorded from Australia in its typical form by Schött in 1917 (226). This form is, however, generally widely distributed, and the writer has seen specimens from the following localities:—Adelaide, S. Aust. (no date, in S.A. Museum collection); Urrbrae, Adelaide, S. Aust., October, 1929 (Waite Institute); Perth, W. Aust., October 4, 1930; Guildford, W. Aust., October 6, 1930; Albany, W. Aust., October 17, 1930; Claremont, W. Aust., December 19, 1930; Belgrave, Vict., April 19, 1931 (H. F. D.); Sherbrook, Vict., April 19, 1931 (H. G. A. & H. F. D.); Studley Park, Vict., August, 1931 (H. G. A.); Pinjarra, W. Aust., September 29, 1931 (D. C. S.).

Var. Inermis Axelson.

Studley Park, Vict., August 1931 (H. G. A.); Woodside, S. Aust., July, 1933 (H. W.).

Hypogastrura manubrialis (Tullberg), 1869.

(Text fig. 1, *d-e*.)

Achorutes manubrialis Tullberg, 1869; *Achorutes Schötti* Reuter, 1895; *Achorutes assimilis* Krausbauer, 1898; *Achorutes neglectus* Börner, 1901.

Description.—Length to 1·5 mm. Colour blackish-brown to grey-blue, mottled. Hairs short curved. Antennae shorter than head. Antennae IV. with 4 olfactory hairs. No eversible sack between antennae III. and IV. Postantennal organ with five peripheral lobes. Claw without inner tooth, with basal lateral tooth. Empodial appendage filiform, with basal lamella. Tibiotarsal tenent hair only indistinctly clavate. Mucro two-thirds as long as dens. Dens ventrally tuberculate. Mucro narrow, with simple or curved apex and simple lamella. Anal spines very small, on separated papillae.

The following varieties are recognised:—

1. (4) With anal spines and papillae.
2. (3) Mucro long and pointed with very narrow lamella. Blackish-brown.—*H. manubrialis* (Tullberg) *forma principalis*.
3. (2) Mucro broad with broader lamella.—Var. *assimilis* (Krausbauer).
4. (1) No anal spines or papillae.—Var. *neglectus* (Börner).

Localities.—*Forma principalis*: South Perth, W. Aust., June 28, 1928 (K. C. R.); Perth, W. Aust., August, 1931; Urrbrae, Adelaide, S. Aust., July, 1930 (Waite Institute). Var. *neglectus* (Börner): Adelaide, S. Aust. (in S.A. Museum collection, without date).

Hypogastrura purpurascens (Lubbock), 1868.

Hypogastrura purpurascens Linnaniemi, 1912 (ad partem).

Description.—Length, 2·0 mm. Colour very variable but mostly blue-black. Hairs short and sparse. Ocelli, 8 on each side on dark patches. Postantennal organ with 4-5 peripheral lobes and central boss. Antennae IV. with olfactory

hairs. No eversible sac between antennae III. and IV. Claw with subapical inner tooth. Empodial appendage with broad inner lamella. Tibiotarsus with 2-3 clavate hairs in a transverse row. Furca with apical hook and distinct narrow lamella to the mucro. Anal spines small, curved, one-fourth as long as hind claw and on rather long papillae.

In the S.A. Museum is a tube of specimens of this species taken in Adelaide, but without data.

Hypogastrura pseudopurpurascens Womersley.

(Text fig. 1, *f*.)

Hypogastrura purpurascens Linnaniemi 1912 (ad partem).

This species was separated from the European *H. purpurascens* Lubbock (265) on the relative disposition of the clavate tibiotarsal hairs, colour, and habitat. In Lubbock's species the clavate tibiotarsal hairs are placed in a transverse line, whereas in this species the lateral hairs are twice as far from the apex as the medial one. The insects are usually of a brownish mottled colour and do not appear to assume the blue-black of typical *purpurascens*. In habitat it appears to be confined to the crevices of rotten bark rather than to damp walls. In his valuable monograph Linnaniemi (158) alludes to this difference in the arrangement of the tibiotarsal hairs, but has apparently not appreciated its importance.

Australian localities for this species are:—Bridgetown, W. Aust., November 3, 1930; Belgrave, Vict., April 19, 1931 (F. H. D.); Sherbrook, Vict., April 19, 1931 (H. G. A.).

Genus Xenylla Tullberg, 1869.

Xenylla maritima Tullberg, 1869.

(Text fig. 1, *g-h*.)

Xenylla brevicauda Reuter, 1895.

Description.—Length, 1·5 mm. Colour, grey-blue to black. Antennae shorter than head, IV. with 3-4 olfactory hairs. Claws without inner teeth. Clavate hairs on tibiotarsi 1 to 2. Mucro fused to dens, with apical hook and narrow lamella. Anal spines small on broad adjacent papillae. Ocelli, 5 on each side. Clothing sparse, of curved, seldom serrated hairs.

This is a well-known European species which has not previously been recorded from Australia. The writer has seen specimens from the following:—Perth, W. Aust., November 24, 1930; same, May 23, 1931; Studley Park, Vict., August, 1931 (H. G. A.); Denmark, W. Aust., October, 1931.

Xenylla grisea Axelson, 1900.

(Text fig. 1, *i-k*.)

? *Xenylla gracilis* Guthrie, 1903.

Description.—Length, 1·2 mm. Colour, grey; seldom bluish. Hairs long and outstanding. Cuticle granular. Antennae two-thirds as long as head, IV. with 4-5 olfactory hairs. Claw toothless. Tibiotarsus with 2 clavate hairs. Furca short and strong. Mucro with broad inner lamella and curved hook-like apex. Anal spines 2, large, on adjacent papillae.

This is a well-known European species. It occurred on decaying bulbs at Claremont, W. Aust., March 3, 1931.

Xenylla littoralis, n. sp.

(Text fig. 2, *a-f*.)

Description.—Length, 1·4 mm. Colour, dark brownish to blue-black. Antennae three-fourths as long as head, ratio of segments I. : II. : III. : IV. =

20 : 20 : 20 : 20, IV. with approximately 4 olfactory hairs, III. with the usual form of sensory organ. Ocelli, 5 on each side on black patches. Postantennal organ absent. Claw with strong inner tooth just beyond the middle. Empodial appendage absent. Tibiotarsus with 2 clavate hairs reaching tip of claw. Furca long, mucro distinctly separated from dens, tapering to a fine point and with narrow entire inner lamella, mucro slightly longer than dens. Dens with two inner setae. Anal spines minute, on papillae of their own length, bases of papillae not touching. Ratio of mucrodens : tibia III. : claw III. = 5 : 3¼ : 2. Clothing of fairly numerous short setae, slightly longer analwards.

This species appears to be of truly littoral habitat. It occurs under stones between high and low tide marks along the coast along with *Neachorutes*

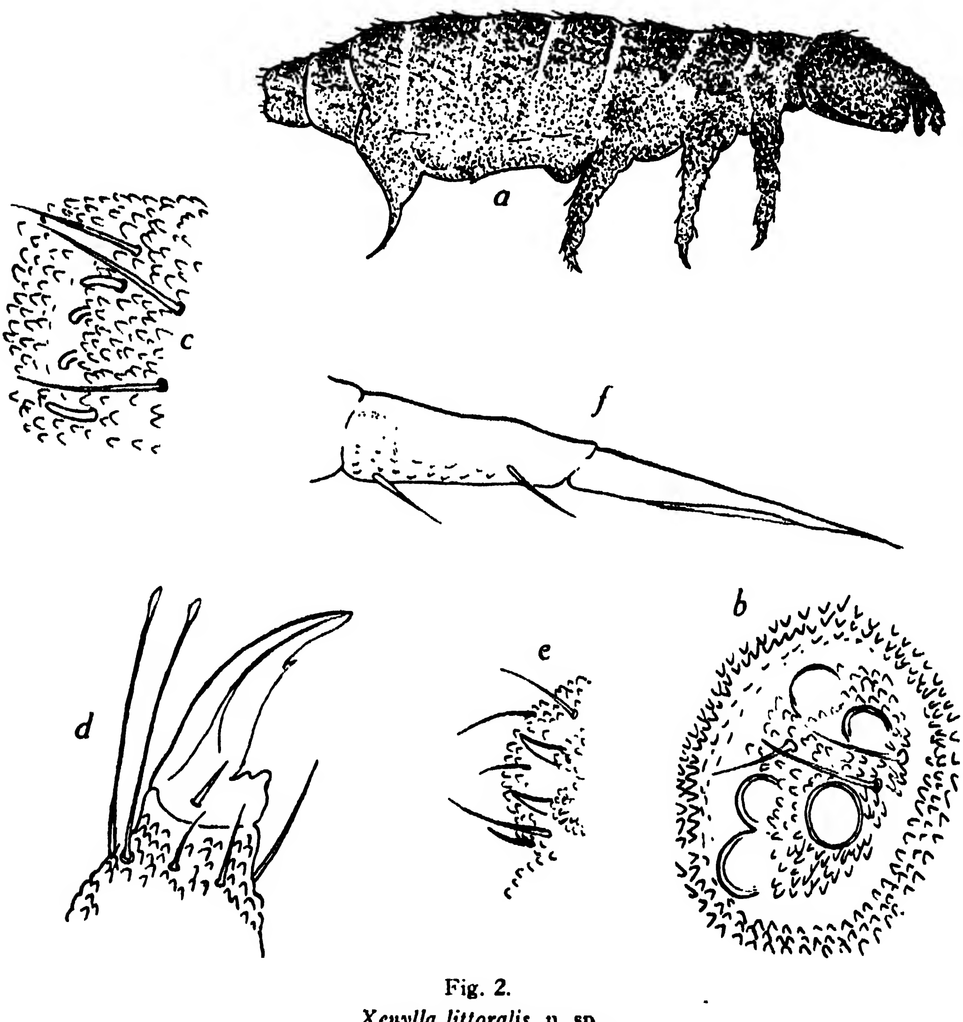


Fig. 2.

Xenylla littoralis, n. sp.

a. Lateral view of entire insect.
b. Ocellar field.
c. Sensory organ on antennae III.
d. Claw and tip of tibiotarsus.
e. Anal spines.
f. Furca from side.

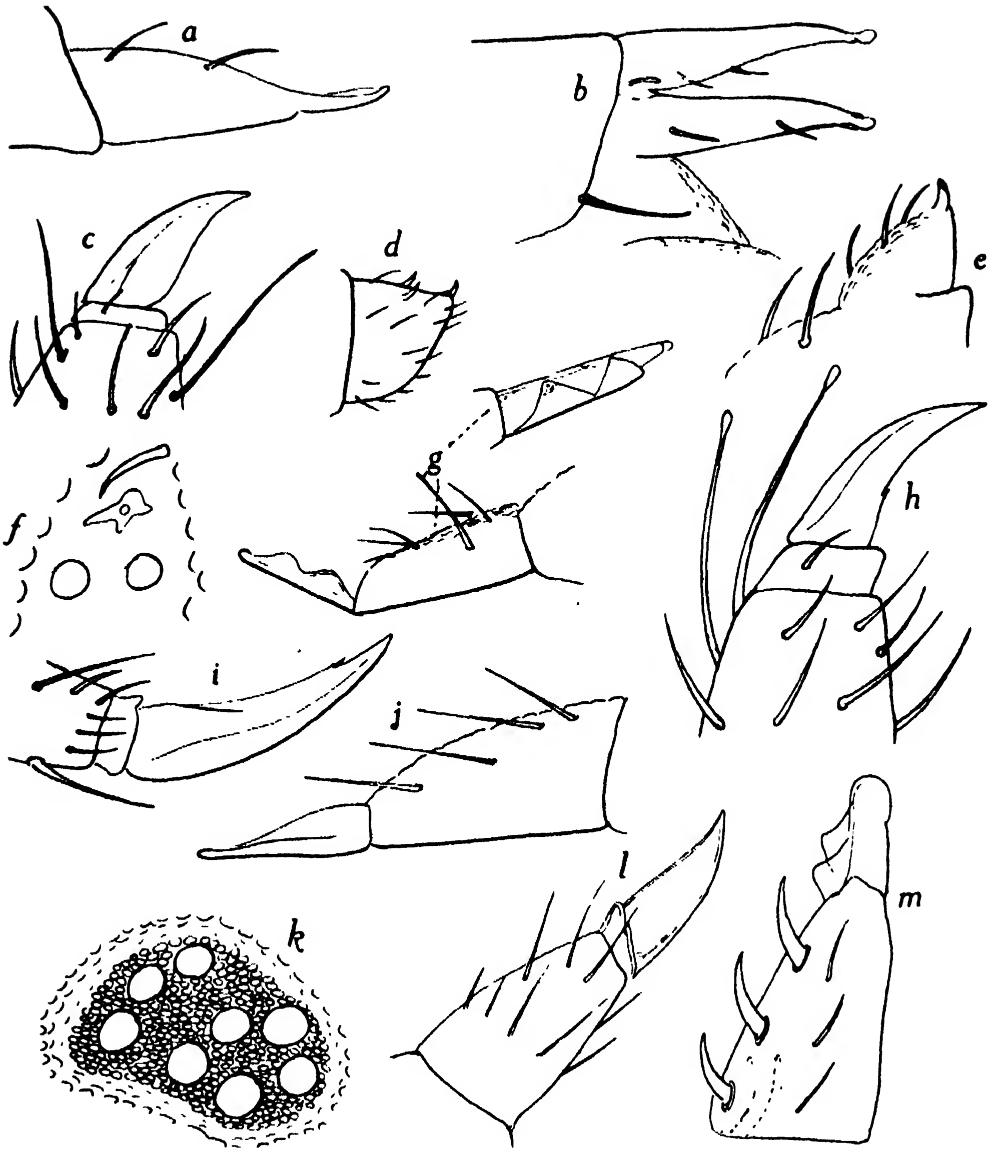


Fig. 3.

a. *Xenylla mucronata* Axelson. Mucrodens from side.
b. „ *occidentalis*, n. sp. Furca.
c. *Friesea mirabilis* (Tullberg). Claw and tip of tibiotarsus.
d. „ „ „ Anal segment from side.
e. „ „ „ Furca from side.
f. *Odontella lamellifera* Axelson. Anterior ocelli and postantennal organ.
g. „ „ „ Furca from side and another view of mucro.
h. „ „ „ Claw and tip of tibiotarsus.
i. *Pseudachorutes rhaeticus* Carl. Claw and tip of tibiotarsus.
j. „ „ „ Furca from side.
k. *Brachystomella acantha*, n. sp. Ocellar field.
l. „ „ „ „ Tibiotarsus and claw.
m. „ „ „ „ Mucro and dens from side.

glauerti, n. sp., and *Axelsonia littoralis* Moniez. It was first obtained by Mr. L. J. Glauert from Rottnest Island, Western Australia. Its nearest allies appear to be *X. longicauda* Fols. from Japan and *X. orientalis* Handschin from the Dutch Indies. From the first it differs in the presence of an inner tooth to the claw and in having anal spines. From the latter the form of the mucro is distinct.

Localities.—Rottnest Island, W. Aust., January 31, 1931 (L. J. G.); Christy's Beach, Port Noarlunga, S. Aust., January 17, 1932 (D. C. S.).

XENYLLA MUCRONATA Axelson, 1903.

(Text fig. 3, *a.*)

Achorutes speciosus Rainbow, 1907.

Description.—Length, 1·3 mm. Colour, bluish. Claws small, with small inner tooth. Furca narrow, mucro separated from dens.

Through the kindness of the Curator of the Australian Museum, Sydney, the writer has been able to examine the type slide of Rainbow's species. This has revealed the fact that *speciosus* Rainbow is but a synonym of *mucronata*. The statement by Rainbow that the eyes in his species number eight on each side is erroneous. Actually there are only five, which is the normal number for the genus *Xenylla*. Possibly the dark pigmentation of the eye-patch misled him. The absence of the empodial appendage also confirms it as a *Xenylla*.

Localities.—Bathurst, N.S.W., 1907 (Rainbow); You Yang Mountains, Vict., September 24, 1931 (Miss J. W. R.); Kenwick, W. Aust., April 4, 1932 (H. W.).

Xenylla occidentalis, n. sp.

(Text fig. 3, *b.*)

Description.—Length, 0·6 mm. Colour, dark brownish. Antennae rather more than half as long as head, ratio of segments I. : II. : III. : IV. = 7 : 7 : 9 : 11, IV. with at least 4-5 olfactory hairs, sensory organ on ant. III. probably normal but indeterminate. Ocelli, 5 on each side on dark patches. Postantennal organ absent. Claws apparently without inner teeth. Empodial appendage absent. Two clavate tibiotarsal hairs. Furca strong, mucro short only about one-fifth the length of dentes, with broad lobe-like appearance, dens with two inner setae. Anal spines very minute, scarcely more than enlarged granulations of the cuticle. Tenaculum with 3 barbs. Mucro four times as long as hind claw.

This species is very distinctive in the structure of the mucro and cannot be confused with any other described species. It has been taken as follows:—Red Hill, W. Aust., August 27, 1931, in fungus (D. C. S.); Kalamunda, W. Aust., May 30, 1931, in fungus (D. C. S.).

Genus FRIESEA Dalla Torre, 1895.

Syn. = *Triaena* Tullberg, 1871; *Macgillivraya* Grote, 1894.

FRIESEA MIRABILIS (Tullberg), 1871.

(Text fig. 3, *c-e.*)

Triaena mirabilis Tullberg, 1871.

Description.—Length, 1·0 mm. Colour, grey-blue, mottled. Antennae shorter than head, IV. with 4-5 olfactory hairs. Claws toothless. Empodial appendage present, without terminal seta. No clavate tibiotarsal hairs. Furca very small, mucro represented only by a hook. Anal spines three, occasionally four, on small papillae. Body hairs not clavate.

A single specimen of this European species was found along with *Xenylla grisea* Axelson, on decaying bulbs at Claremont, W. Aust., March 19, 1931.

Several specimens, including one of the form *quadrispina* Axelson with four anal spines, were taken in garden soil by means of the Berlese funnel at Glen Osmond, South Australia, March, 1933.

Genus CERATRIMERIA Börner, 1906.

CERATRIMERIA MAXIMA (Schött).

Schöttella maxima Schött, 1901.

Description.—Length, 2·5 mm. Colour, grey-blue with light stripes, ventral surface whitish. Body stumpy, segments dorsally with prominent pleural areas. Antennae short, segments III. and IV. indistinctly separated, IV. with trilobed terminal organ. Ocelli, 8 on each side. Postantennal organ half elliptical with about 30 tubercles. Mouth parts suctorial. Integument with hexagonal areas. Claws broad with lateral lamellae, with large lateral teeth. Empodial appendage absent. Anal spines absent.

This interesting species was recorded from Queensland by Schött (226) in 1917. The writer has had specimens from Belgrave, Vict., April 19, 1931 (H. F. D. & H. G. A.); Sherbrook Falls, Vict., April 19, 1931 (H. G. A.).

Genus ODONTELLA Schäffer, 1897.

Syn. = *Xenyllodes* Axelson, 1903 (ad partem).

ODONTELLA LAMELLIFERA Axelson, 1903.

(Text fig. 3, *f-h*.)

Xenyllodes lamellifera Axelson, 1903; *Odontella succia* Wahlgren, 1906.

Description.—Length, 1·3 mm. Colour, blue-grey with distinct mottlings, skin richly tuberculate. Hairs short and sparse. Antennae shorter than head, segment IV. with curved olfactory hairs. Ocelli, 5 on each side. Postantennal organ with 4 peripheral lobes in a groove. Claw toothless. Tibiotarsi with two simple spur hairs. Mucro equal to dens in length, with two characteristic lobes on inner lamella. Anal horns about equal in size to the cuticular granules, two in number.

This is a rare species, hitherto known only from Northern Europe. It is, therefore, of much interest that it should be found in Australia. It was obtained from the following localities by means of the Berlese funnel:—Sherbrook Falls, Vict., April 19, 1931 (H G. A.); Belgrave, Vict., April 19, 1931 (H. F. D.).

Genus PSEUDACHORUTES Tullberg, 1871.

Syn. = *Schöttella* Schäffer, 1896 (ad partem).

PSEUDACHORUTES RHAETICUS (Carl), 1899.

(Text fig. 3, *i-j*.)

Schöttella rhaetica Carl, 1899.

Description.—Length, 1·5-3·0 mm. Colour, dark brown to black. Antennae with trilobed apical knob and 3-4 olfactory hairs on segment IV. Postantennal organ with 12-15 peripheral lobes. Claw toothless, seldom with small inner tooth and lateral tooth. Clavate tibiotarsal hairs and anal horns absent. Dens somewhat swollen and with strong tubercles. Mucro straight dorsally, apex curved, lamella with notched edge. Hairs short and sparse. Mandibles present and needle-like.

This species is markedly distinct from the only true species of this genus known from Australia, namely *P. incertus* Schött. It can now be recorded from the following places:—Parkerville, W. Aust., October 5, 1930 (H. W.); Belgrave,

Vict., April 19, 1931 (H. G. A.); Sherbrook, Vict., April 19, 1931 (H. G. A. & H. F. D.); You Yang Mountains, Vict., September 24, 1931 (Miss J. W. R.); Sassafras, Vict., December, 1931 (H. G. A.).

Genus BRACHYSTOMELLA Agren.

Syn. = *Schöttella,* Schäffer, 1896 (ad partem); Schtscherbakow, 1899 (ad partem); Carl, 1901 (ad partem); Schött, 1902 (ad partem). *Brachystomella,* Agren, 1903; Stach, 1929. *Schöttelodes* Becker, 1905. *Chondrachorutes* Wahlgren, 1906; Denis, 1924.

In 1929 Stach (238) restudied the species *Schöttella parvula* Schäffer, as well as all the then known allied species. He went into the position very thoroughly and showed that Schäffer's species belonged to the genus *Brachystomella* of Agren, which differed very definitely from *Pseudachorutes* s. str. in the entire absence

Fig. 4.

a.	*Brachystomella parvula* (Schäffer).	Sensory organ on antennae III.
b.	" " "	Anterior ocelli and postant. organ.
c.		Claw and tip of tibiotarsus.
d.	"	Mucrodens.
e.	*fungicola*, n. sp.,	Head of maxilla.
f.		Antennae IV. and tip of III.
g.		Anterior ocelli and postant. organ.
h.		Claw and tip of tibiotarsus.
i.		Mucro from side.
j.	*afurcata*	Apex of antennae IV.
k.		Sensory organ of antennae III.
l.		Anterior ocelli and postant. organ.
m.		Head of maxilla.
n.		Claw and tip of tibiotarsus.

of mandibles. In the place of these organs, the heads of the maxillae are modified by being strongly toothed.

BRACHYSTOMELLA PARVULA (Schäffer), 1896.
(Text fig. 4, *a-d.*)

Schöttella parvula Schäffer, 1896; *Schöttella media* Axelson, 1900; *Chondrachorutes wahlgreni* Denis, 1924; *Schöttella minor* Schtscherbakow, 1899; *Schöttella albomaculata* Carl, 1901; *? Schöttella crassicornis* Schött, 1902; *? Brachystomella maritima* Agren, 1903.

Description.—Of *Pseudachorutes* build. Length, 1·0 mm. Colour, brownish, mottled. Ocelli, 8 on each side. Postantennal organ with 5-6 peripheral lobes. Tibiotarsi with 2-3 long hairs, not clavate or only indistinctly so. Claws with inner tooth. Mucro short and tapering. Dens with 5-6 setae. Mandibles wanting, maxillae with broad, toothed head.

This European species appears to be common and widely distributed throughout the southern part of Australia. Specimens have been seen from the following localities:—Corney Point, S. Aust., date? (M. Klem); South Perth, W. Aust., June 28, 1926 (K. O. R.); Beverley, W. Aust., October 2, 1930 (H. W.); Nangara, W. Aust., November 11, 1930 (B. A. O'C.); Crawley, W. Aust., May 14, 1931 (H. W.); National Park, W. Aust., September 3, 1931 (D. C. S.); Mandurah, W. Aust., April 29, 1931 (H. W.); Queenwood, Preston Valley, W. Aust., June 12, 1931 (H. W.); Encounter Bay, S. Aust., May, 1929 (J. B. C.); Urrbrae, Adelaide, S. Aust., 1930 (Waite Institute); Studley Park, Vict., August, 1931 (H. G. A.).

Brachystomella afurcata, n. sp.
(Text fig. 4, *j-n.*)

Description.—Length, 1·2 mm. Colour, bluish-black. Antennae slightly shorter than head, ratio of segments I. : II. : III. : IV. = 8 : 8 : 10 : 12, III. and IV. only indistinctly separated, IV. with trilobed apical knob and 4-5 olfactory hairs, antennal organ III. as figured. Ocelli 8 on each side on a dark field. Postantennal organ with 5 peripheral lobes as figured. Mandibles absent, head of maxillae broad and toothed. Claws without teeth. Tibiotarsus with 3 strongly clavate hairs, one subapical and outside, two inside and more proximal. Furca absent. Clothing of sparse but fairly long and fine setae.

This species is closely related to *B. parvula* Schäffer, but differs in the absence of the furca and the strongly clavate tibiotarsal hairs.

Localities.—Beverley, W. Aust., June 4, 1931 (H. W.); Pine Island, Murrumbidgee River, F. C. T., June, 1931 (R. J. T.); Red Hill, W. Aust., August 27, 1931 (D. C. S.).

Brachystomella acantha, n. sp.
(Text fig. 3, *k-m.*)

Description.—Length, 0·9-1·0 mm. Colour, yellowish. Head and antennae bluish, eye patches black. Antennae slightly shorter than the head, ratio of segments I. : II. : III. + IV. = 10 : 10 : 20, IV. with trilobed apical knob, organ on ant. III. indeterminate. Ocelli, 8 on each side on black patches. Postantennal organ wanting. Claws strong without inner teeth. No clavate tibiotarsal hairs. Empodial appendage wanting. Mandibles wanting. Head of maxillae as in genus. Furca small, dens twice as long as mucro with three strong, curved spines on ventral aspect, mucro with inner and outer lamellae with lobes, apex of mucro rounded. Clothing of sparse, short fine hairs. Cuticle finely granular.

This rather small but strikingly distinct species was found in numbers in a species of *Boletus* at Crawley, Western Australia, May, 1931 (D. C. S.) along with *Brachystomella fungicola,* n. sp.

Brachystomella fungicola, n. sp.

(Text fig. 4, *e-i.*)

Description.—Length, to 3·5 mm. Colour, brownish, lighter ventrally. Antennae as long as head, ratio of antennal segments I. : II. : III. : IV. = 30 : 35 : 25 : 35, segments III. and IV. indistinctly separated, IV. with trilobed apical knob and 2 (?) olfactory hairs, III. with organ as figured. Ocelli, 8 on each side on a dark field. Postantennal organ with 4 peripheral lobes. Mandibles wanting, head of maxillae as figured. Tibiotarsi without clavate hairs. Claws strong with inner tooth. Empodial appendage absent. Furca well developed, dens broad and tuberculate and twice as long as mucro, mucro with inner and outer lamellae, basally granular. Cuticle finely granular and clothed with fine and short but sparse hairs.

This species is very distinctive in the structure of the mucro and claws. It has been taken at Mandurah, W. Aust, April 30, 1931; Crawley, W. Aust., May, 1931 (D. C. S.).

Brachystomella anomala, n. sp.

(Text fig. 5, *a-g.*)

Description.—Length, 2·5 mm. Colour, bluish-brown. Antennae slightly shorter than head, ratio of antennal segments I. : II. : III. : IV. = 10 : 10 :

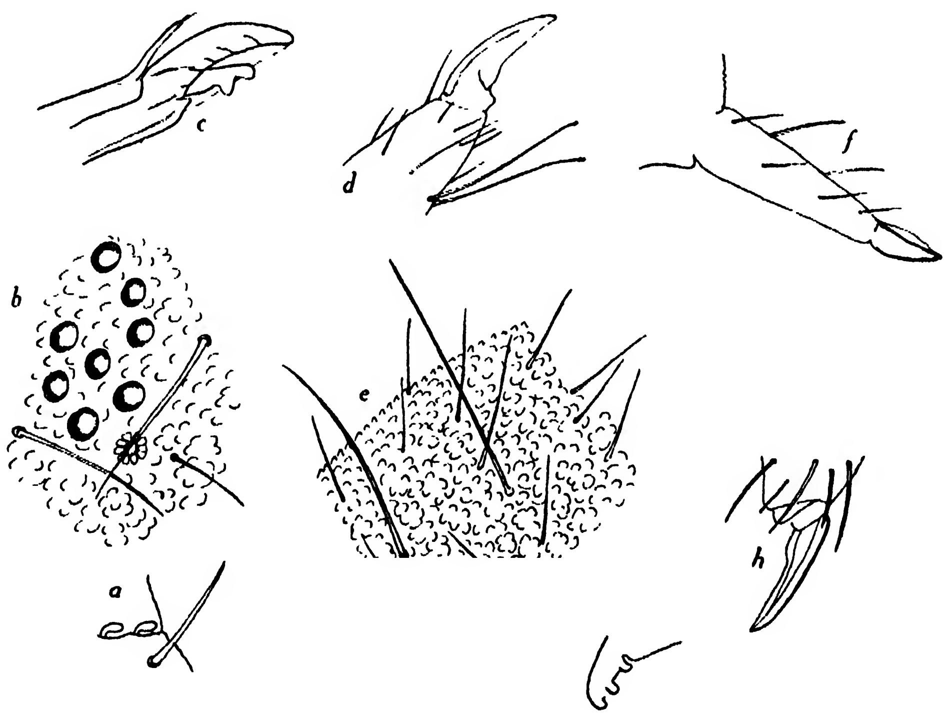


Fig. 5.

a. *Brachystomella anomala*, n. sp. Sensory organ of antennae III.
b. „ „ „ „ Ocelli and postantennal organ.
c. Head of maxilla.
d. Tip of tibiotarsus and claw
e. Dorsal cuticle.
f. Dens and mucro from side.
g. Rami.
h. *Anurida granaria* (Nicolet). Claw.

10 : 11, IV. with small trilobed apical knob, olfactory hairs (?), organ on antennae III. indeterminate. Ocelli, 8 on each side, not on a pigmented field. Postantennal organ rosette-like, with 12 lobes. Mandibles absent, head of maxillae as in *Anurida* (text fig. 5, *c*). Claws without inner teeth. Empodial appendage absent. Tibiotarsal clavate hairs 2 on inner side, long. Furca well developed, dens granular and about three times as long as the mucro, mucro broad with simple inner lamella. Rami of tenaculum with 3 barbs. Cuticle strongly granular with numerous long, simple setae.

Described from four specimens from the following localities:—Sassafras, Vict., December, 1931 (H. G. A.), 3 specimens; Sherbrook, Vict., April 19, 1931 (H. G. A.), 1 specimen.

It is with considerable doubt that this species is placed in the genus *Brachystomella*. From other species of this genus it differs very definitely in the strongly granular structure of the cuticle, in this respect recalling that of *Anurida granaria* (Nicolet). Mandibles are wanting, but the complex head of the maxilla resembles that of *Anurida* rather than *Brachystomella*. The ocelli are 8 on each side, and not 5 as in *Anurida maritima* Guerin, or absent as in *A. granaria* (Nicolet). The postantennal organ also resembles that of the latter species. The furca is similar in structure to that of *Brachystomella parvula* (Schäffer).

In all probability this species will have to be placed ultimately in a new genus.

Genus ANURIDA Laboulbene, 1865.

Syn.=*Anoura* Nicolet, 1847 (ad partem); *Aphoromma* MacGillivray, 1893; *Anurida* Schött, 1893.

ANURIDA GRANARIA (Nicolet), 1847.
(Text fig. 5, *h*.)

Aphoromma granaria MacGillivray, 1893.

Description.—Length, 1·8 mm. White. Ocelli absent. Postantennal organ present, rosette-like with 12-21 lobes. Antennae shorter than head. Antennae IV. with 8 olfactory hairs. Claws toothless. Empodial appendage absent or only represented by a small nodular piece without bristle. Hairs short and sparse. Cuticle with large granules.

This is a typical soil inhabiting species and most probably has been introduced into Australia. It has been found in material from Mount Lofty Ranges, Adelaide, S. Aust., November 17, 1931 (D. C. S.).

Genus **Neachorutes**, n. gen.

Description.—General facies as in *Anurida maritima* Guerin. Antennae 4-segmented, longer than head. Ocelli, 8 on each side on dark field. Postantennal organ absent. Furca long and simple, dens somewhat bowed in the horizontal, mucro small and not distinctly separated from dens. Mandibles present, strongly toothed apically but without molar area. Claws strong. Tibiotarsi without clavate hairs. Male with last abdominal segment strongly produced.

Genotype *Neachorutes glauerti*, n. sp.

Neachorutes glauerti, n. sp.
(Text fig. 6, *a-i*.)

Description.—Length of male, 3·0 mm.; of female, 2·4 mm. Colour, deep bluish-black. Antennae nearly twice as long as head, ratio of segments I. : II. : III. : IV. = 6 : 8 : 12 : 10. Ocelli, 8 on each side on a dark field. Postantennal organ absent. Clavate tibiotarsal hairs absent. Furca very well developed, long

and thin, especially the dentes which are slender, parallel-sided and highly granular. Mucro small, less than one-seventh of the length of the dens and with distinct lamella. Rami of tenaculum with 4 barbs. Clothing very sparse except on appendages, on apical antennal segments the setae are twice the width of segments, all setae simple. The adult male differs from the female in that the last abdominal segment is produced in an upturned manner, the prolongation being as long as the basal segment itself. The cuticle richly granular.

This genus and species is of littoral habitat and occurs under stones between high and low water marks. It can withstand immersion in a good depth of water, and is often taken in numbers in the crevices of rocks lying in several feet of water. From its habitat it can possibly be regarded as replacing *Anurida maritima* Guerin of the Northern Hemisphere in the Australian region.

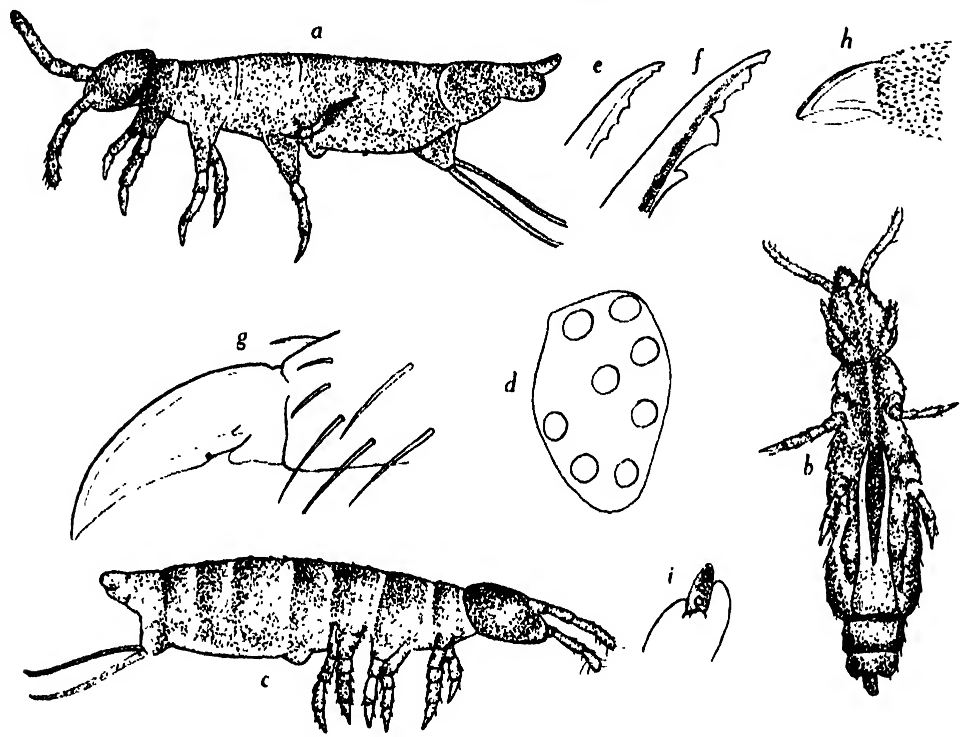


Fig. 6.

Neachorutes glauerti, n. g., n. sp.

a. Male insect, side view.
b. „ „ ventral view
c. Female insect, side view.
d. Ocellar field.
e. Head of maxilla.
f. Head of mandible.
g. Tip of tibiotarsus and claw.
h. Tip of dens and mucro.
i. Rami.

It was first discovered by Mr. L. J. Glauert, of the Perth Museum, on Rottnest Island, Western Australia, in the described habitat, along with another interesting littoral species, *Axelsonia littoralis* (Moniez). The detailed localities are:— Longreach Bay, Rottnest Island, W. Aust., January 3-6, 1930 (L. J. G.); Fresh-

water Bay, Swan River, W. Aust., February 2, 1930 (Miss Horgan); Point Perron, W. Aust., 1931 (H. W.); Christy's Beach, S. Aust., January 17, 1931 (D. C. S.); Marino, S. Aust., March 24, 1929 (R. H.).

Genus ACHORUTES Templeton, Börner.

Syn.=*Achorutes* Templeton, 1835 (ad partem) ? *Blax* Koch, 1840; *Anoura* Gervais, 1842; *Anura* Tullberg, 1869; *Neanura* MacGillivray, 1893.

ACHORUTES ROSACEUS Schött, 1917.

Description.—Length, 1·5-2·0 mm. Colour, in life, rose; in spirit, white. Facies of typical *Achorutes* form. Cuticle uniformly tuberculate. Ocelli, 2 on each side on edge of head prominence. Postantennal organ absent. Antennae IV. with a trilobed organ. Claw toothless. Dorsal setae strong but simple.

This species was described by Schött from North Queensland in 1917 (226). In Western Australia it seems to be generally abundant and has been taken as follows:—Perth, W. Aust., October 4, 1930; Denmark, W. Aust., October 17, 1930 (H. W.); Margaret River, W. Aust., April 25, 1931 (L. J. N.); Mandurah, W. Aust., April 30, 1931 (H. W.); Mount Lofty Ranges, S. Aust., March 2, 1931 (H. G. A.).

ACHORUTES CIRRATUS Schött, 1917.

Description.—Length, 1·5 mm. Colour, in spirit, white. Cuticle in regular fields and prominences of tubercles. Ocelli, 2 on each side, not pigmented. Postantennal organ wanting. Antennae IV. with an apical trilobed organ. Claws simple. Setae on outstanding prominences of abdomen, large, strongly feathered but not clavate.

This species, also described by Schött from North Queensland, has been since found in the following localities:—Studley Park, Vict., August, 1931 (H. G. A.); You Yang Mountains, Vict., September 24, 1931 (Miss J. R.).

Achorutes newmani, n. sp.

(Text fig. 7, *d-e.*)

Description.—Length, to 3·0 mm. Colour, in life, creamy white. Antennae only half as long as head, segments subequal, IV. with 4 or 5 olfactory hairs, antennal organ III. inconspicuous and indeterminate. Ocelli, 3 on each side, without pigment, one placed sublaterally and subposteriorly on a prominence, the other two not on a prominence, their own diameter apart and four to five times their diameter from the anterior edge of the prominence on which is the other ocellus. The dorsal surface is highly tubercular and shows a number of prominences as is usual in this genus, as follows:—On head, three transverse rows, anterior one of two each with four strong setae, medial row of five, the three middle ones with 3 setae and the outer ones with 4, a posterior row of six, the middle four with 2 setae and the outer ones with 4 setae; thorax I., a row of six, the outer prominences with 1 setae, the others with 2 setae; thorax II., a row of six, outer ones with 4, others with 3 setae; thorax III., row of six as in thorax II; abdomen I., II., and III. with a row of six, median pair with 3 setae, mediolateral pair with 3 strong setae and 1 fine seta, ectolateral with 2 setae; abdomen IV. with row of six, median pair with 2 setae, mediolateral with 2 strong and 1 fine setae, ectolateral with 3 setae; abdomen V. with row of four, median pair with 3 setae, outer ones with 3 strong and 1 fine setae; abdomen VI. with two prominences, each with 6 setae dorsally. Mouth organs small, needle-like, mandibles present without molar plate. Claws without inner tooth, but basal lateral teeth present, tuberculate almost to tip

of claw. Empodial appendage absent. Furca absent. Clothing of the strong, rather blunt and indistinctly ciliated setae as on the prominences.

This species is closely related to *A. zehntneri* Handschin described from Java. It differs in not having the carmine colouration in life of Handschin's species and in the absence of an inner tooth to the claw. The relative disposition of the ocelli is also distinctive. It is named in honour of the Government Entomologist of Western Australia, in whose company the writer was when he first found this species in large numbers under loose bark at Picton Junction, Western Australia, October 10, 1930.

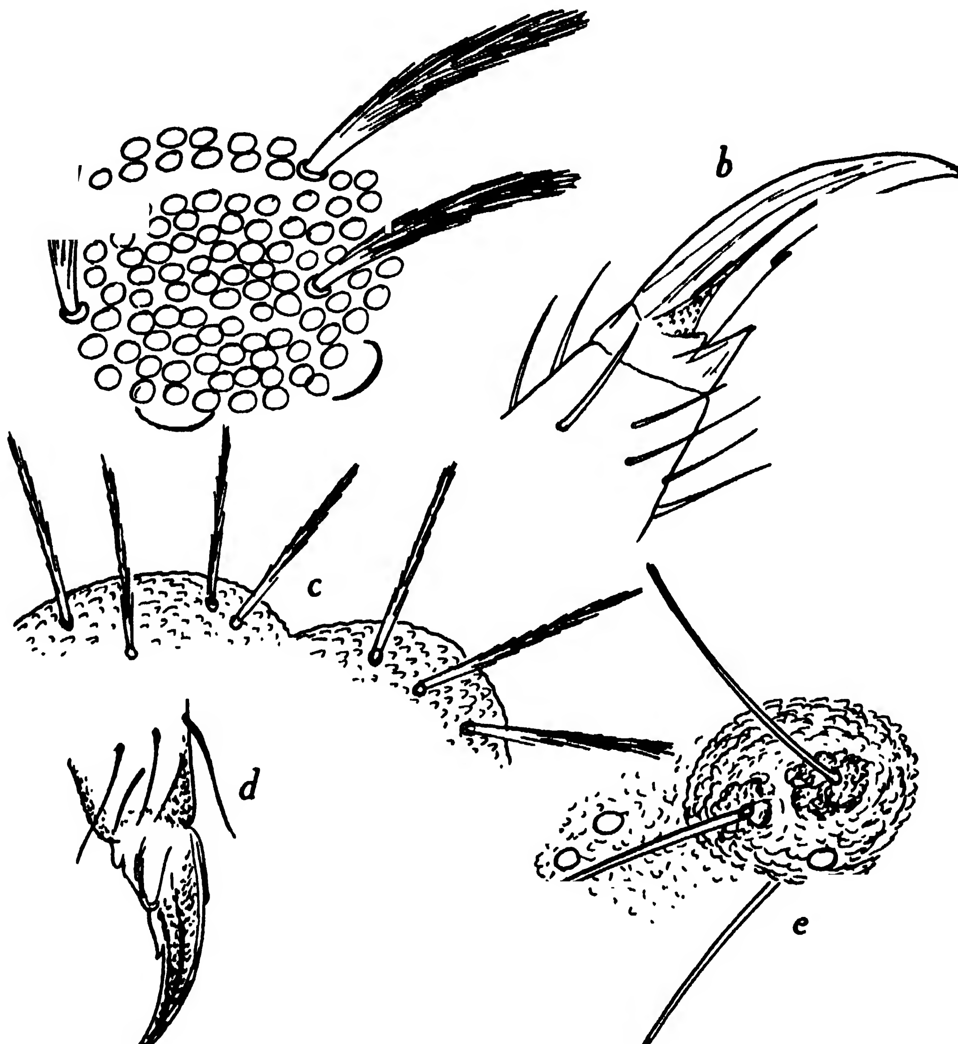


Fig. 7.

a. *Achorutes hirtellus* Börner. Ocelli.
b. ,, ,, ,, Tip of tibiotarsus and claw.
c. ,, ,, ,, Anal tubercles and setae.
d. ,, *newmani*, n. sp. Tip of tibiotarsus and claw.
e. ,, ,, ,, ,, Ocelli.

ACHORUTES HIRTELLUS Börner, 1906.

(Text fig. 7, *a-c.*)

Description.—Length, 2·0 mm. In spirit, as in life, yellowish-white. Claw with ventral tooth. Ocelli, 2 on each side, unpigmented. Dorsal setae long, feathered and strongly clavate.

A single specimen taken at Sherbrook Falls, Victoria, April 19, 1931 (H. G. A.) is somewhat doubtfully referred to this species.

Family ONYCHIURIDAE Börner, 1913.

Syn.=*Aphorurinae* Börner, 1901; *Aphorurini* Börner, 1901; *Onychiurinae* Börner, 1901.

Genus ONYCHIURUS Gervais, 1841; Börner, 1901.

Syn.=*Podura* Linne, 1758 (ad partem); *Lipura* Burmeister, 1838 (ad partem); *Onychiurus* Gervais, 1841, in littoris; *Adicranus* Bourlet, 1843 (ad partem); *Anurophorus* Nicolet, 1841 (ad partem); *Aphorura* MacGillivray, 1893; *Protaphorura* Börner, 1909.

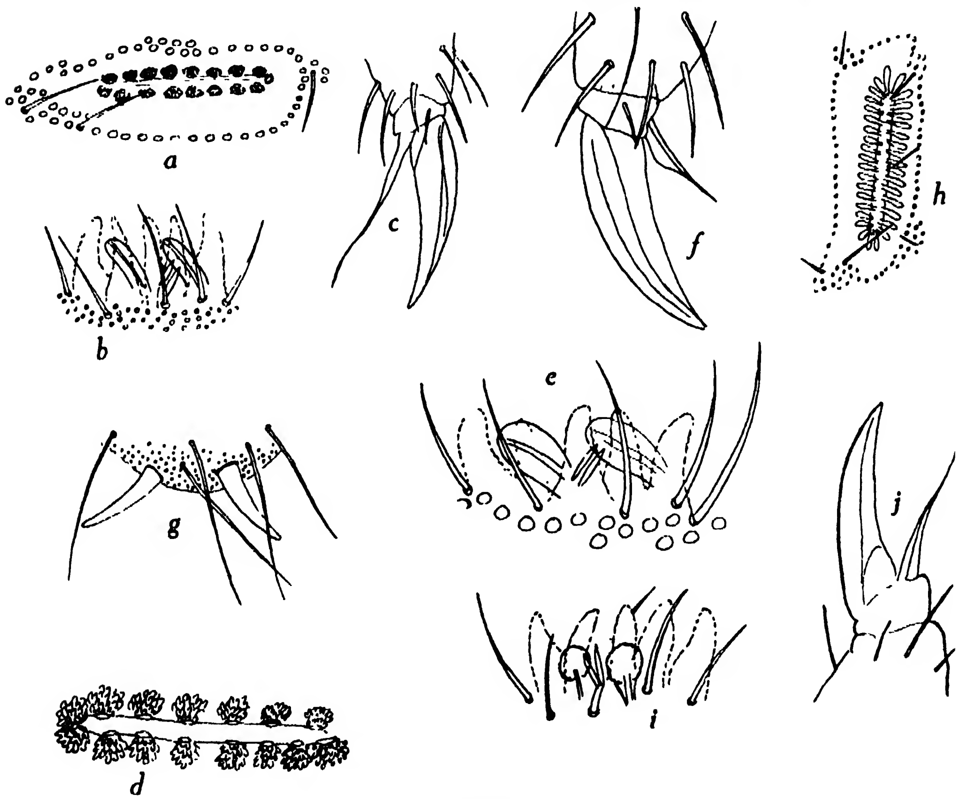


Fig. 8.

a. *Onychiurus fimetarius* (Linn.) Postantennal organ.
b. „ „ „ Antennal sensory organ.
c. „ „ Claw and tip of tibiotarsus.
d. *ambulans* „ Postantennal organ.
e. Antennal sensory organ.
f. Claw and tip of tibiotarsus.
g. „ „ Anal spines.
h. *armatus* (Tullberg). Postantennal organ.
i. „ „ Antennal sensory organ.
j. „ v. *denticulata* Handschin. Claw.

ONYCHIURUS FIMETARIUS (Linne, Lubbock).

(Text fig. 8, *a-c.*)

Podura fimetaria Linne, 1766; *Lipura fimetaria* Lubbock, 1867; *Lipura inermis* Tullberg, 1869; *Lipura wrightii* Carpenter, 1895; *Aphorura inermis* Schäffer, 1896; *Onychiurus pseudofimetarius* Folsom, 1916.

Description.—Length, 1·5-2·0 mm. White. Sensory clubs of antennal organ III. smooth. Postantennal organ with 12-16 clusters of tubercles. Pseudocelli on antennae bases 2, behind 1. Claw toothless, small. Empodial appendage with bristle as long as claw. Anal spines wanting.

This is a common inhabitant of garden soils, and when it occurs in large numbers often does considerable damage. In Australia it has been found as follows:—In hot-houses, Government Gardens, Perth, W. Aust., November 18, 1930; ditto, February 13, 1931 (H. W.); Mount Lofty Ranges, S. Aust., November 7, 1931 (D. C. S.); Glen Osmond, S. Aust., April, 1932 (D. C. S.); on *Cortinarius*, sp., Neutral Bay, N.S.W., 1929 (J. B. C.); in S.A. Museum, without data; in green-house, Adelaide, March, 1933 (H. M. H.).

ONYCHIURUS AMBULANS (Linne, Nicolet).

(Text fig 8, *d-g.*)

Podura ambulans Linne, 1758 (ad partem); *Anurophorus ambulans* Nicolet, 1847; *Lipura ambulans* Lubbock, 1862; *Aphorura ambulans* MacGillivray, 1862; ? *Aphorura willemi* Börner, 1901.

Description.—Length, 2·0 mm. White. Antennal organ III. with smooth sensory clubs. Postantennal organ with 12-15 granular tubercles. Antennae bases with 2 pseudocelli. Claws toothless. Empodial appendage with basal lamella and bristle. Anal spines present, large and slightly curved, on smaller papillae.

This species is to be found in soil like the preceding one. It is very common in Europe where it exists in two forms, *O. ambulans* (Nicolet) *forma principalis*, with anal spines, and *O. ambulans* var. *inermis* Agren, without anal spines. It occurs commonly in most cultivated soils in the Perth area of Western Australia, but only the typical form has so far been found.

ONYCHIURUS ARMATUS (Tullberg), 1869.

(Text fig. 8, *h-j.*)

Lipura armata Tullberg, 1869; ? *Lipura fimetaria* Dalla Torre, 1888; *Aphorura armata* Reuter, 1898.

Description.—Length, 0·9-2·5 mm. White. Antennal organ III. with sensory clubs like bunches of grapes. Postantennal organ with 16-32 simple tubercles. Claws with or without teeth. Anal spines long, weakly curved, or papillae sometimes absent.

This is another common soil inhabitant in Europe. Owing to its attacking the rootlets of plants and killing them by sheer weight of numbers, it must be regarded as of economic importance. The variety without anal spines, var. *inermis* Agren, has not yet been found in Australia, but both the typical form and the variety *denticulata* Handschin, which has an inner tooth to the claw, have been found as follows:—*Forma principalis:* Government Gardens, Perth, W. Aust., February 2, 1932; in green-house, Adelaide, S. Aust., March, 1933 (H. M. H.). Var. *denticulata* Handschin: Mount Lofty Ranges, S. Aust., October 29, 1931.

Genus Tullbergia Lubbock, 1876.

Syn.=*Stenaphorura* Absolon. 1900; *Mesaphorura* Börner, 1901; *Börneria* Willem, 1902.

Tullbergia trisetosa (Schäffer) Börner.

(Text fig. 9, *a-c*.)

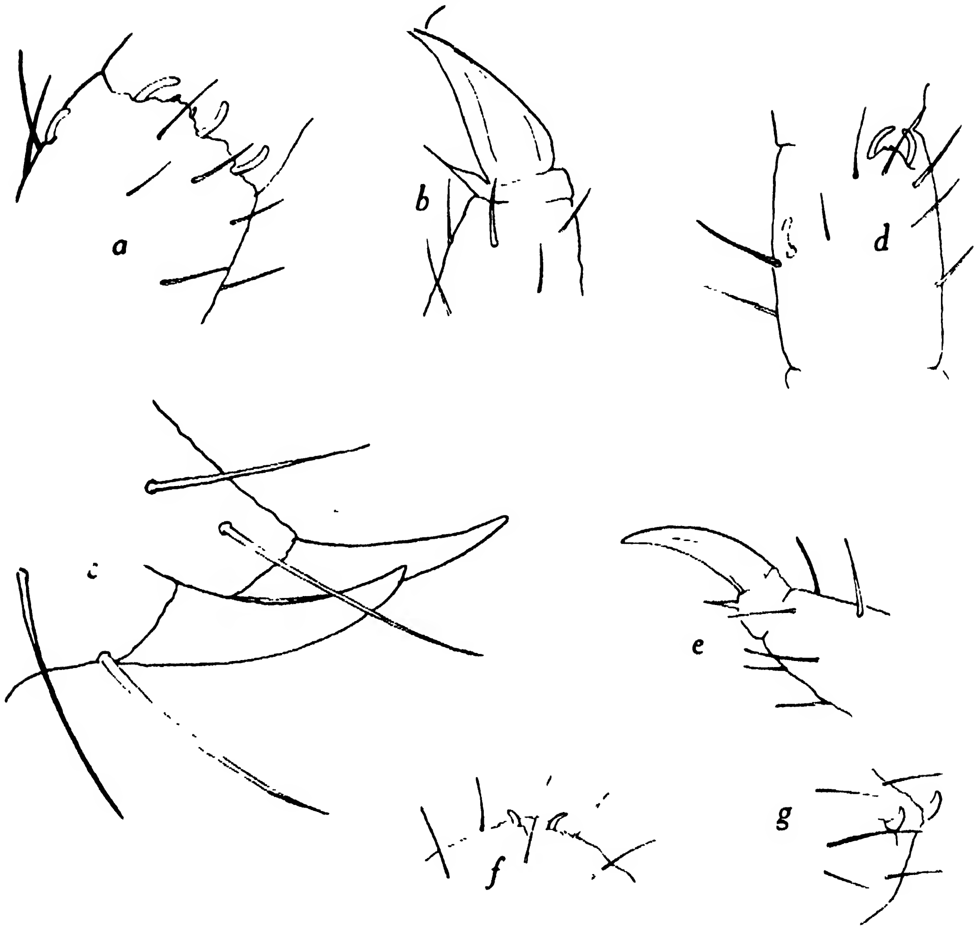


Fig. 9.

a	*Tullbergia trisetosa* (Schäffer).	Sensory organ on antennae III
b.	,, ,, ,,	Claw and tip of tibiotarsus.
c.	,,	Anal spines.
d.	*australis*, n. sp.	Sensory organ on antennae III.
e.	,, ,,	Claw and tip of tibiotarsus.
f.	,, ,,	Anal spines from above.
g.	,, ,, ,, ,, ,,	side.

Aphorura trisetosa Schäffer, 1897; *Aphorura trisetosa* var. *quadrisetosa* Willem, 1902; *Börneria quadrisetosa* Willem, 1902.

Description.—Length, 1·4 mm. Colour, whitish-yellow. Antennae slightly shorter than the head, ratio of antennal segments I. : II. : III. : IV. = 7½ : 7½ : 11 : 12, IV. with 3 or 4 olfactory hairs, III. with sensory organ of 3 parallel-sided stout sensory clubs lying behind a layer or fold of the cuticle; between the two inner clubs is a pair of minute sensory rods; papillae apparently absent; on

ventral side of antennae III., at about the middle of the segment, is a fourth slightly curved and parallel-sided club. Antennae base marked off from the rest of the head by a smaller size of the cuticular tubercles. Claws strong, without inner tooth. Empodial appendage present with narrow inner basal lamella and apical bristle which almost reaches the middle of the claw. Clavate tibiotarsal hairs absent. Eyes absent. Postantennal organ long with 80-100 tubercles. Furca absent. Anal spines 2, long and slightly curved on papillae of almost their own length. Anal spines twice as long as the hind claws. Cuticle strongly granular. Clothing of fine and long setae, especially analwards. Pseudocelli = ant. base 1, base of head 1 plus 1, thorax I., II., and III., 1 plus 1, abdomen I.-III. 2 plus 2, IV.-V. 1 plus 1, VI. 0.

The Australian specimens which are referred to this species differ in the number of tubercles in the postantennal organ from the figures given by Börner (35). His number is 100, whereas in the material examined it is round about 80 The localities are:—Sherbrook Falls, Vict., April 19, 1931 (H. G. A. and H. F. D.); Belgrave, Vict., April 19, 1931 (H. G. A.); Mount Lofty Ranges, S. Aust., November 7, 1931 (D. C. S.); You Yang Mountains, Vict., September 9, 1931 (Miss J. W. R.); Specimens in the S.A. Museum (?), Adelaide, no other data.

Tullbergia australica, n. sp.

(Text fig. 9, *d-g.*)

Description.—Length, 0·9 mm. Colour, white. Antennae slightly shorter than head, ratio of segments I. : II. : III. : IV. = 4 : 4 : 6 : 7, IV. with 4 olfactory hairs, organ on III. with 2 strongly curved parallel-sided sensory clubs almost touching at their tips, and two minute rods. Ventrally on ant. III. there is also a third sensory club. Cuticular granules on antennae bases about the same size as those on the head. Ocelli absent. Postantennal organ with about 60 tubercles. Claws without inner teeth. Empodial appendage present with small inner lamella and terminal bristle which does not reach to more than one-third the length of claw. Clavate tibiotarsal hairs absent. Furca absent. Anal spines small, on small papillae not touching at the base. Pseudocelli large. Base of antennae with 1, base of head 1 plus 1, thorax I. to abdomen III. 1 plus 1, IV. 2 plus 2, V. 1 plus 1. Cuticle finely granular.

This species is very closely related to the European *T. krausbaueri* Börner, from which it differs in the presence of the third club on antennae III., in the number of lobes in the postantennal organ and in the number and arrangement of the pseudocelli. It has been taken as follows:—Crawley, W. Aust., October 2, 1930 (D. C. S.); November 19, 1930 (D. C. S.); April 16, 1931 (H. W.); Kalamunda, W. Aust., June 15, 1930 (D. C. S.); Sassafras, Vict., 1931 (H. G. A.).

Key to the Genera of the Collembola-Arthropleona.

Superfamily PODUROIDEA.

A. Without pseudocelli. With or without ocelli. Sensory organ of antennae III. with rods but without sensory cones or outer papillae. Antennae IV. without subapical pit but always with retractile sensory knob.

I. Head hypognathus. Ocelli placed on hind part of head. Dentes bowed horizontally, annulated distally, over-reaching ventral tube. Manubrium resembling that of the Collembola-Symphypleona, with a special medial support piece of the dentes.

Family PODURIDAE Börner, 1906.
(A single genus and species *Podura aquatica* Linne, not known from Australia.)

II. Head obliquely prognathus. With or without ocelli, if present then on the front of the head. Dentes not annulated, fairly straight, seldom reaching ventral tube, or the furca more or less reduced. When present the furca is simple and without the medial support piece of the dentes.

Family HYPOGASTRURIDAE Börner, 1906.

(a) Mandibles with well-developed molar plate.

Subfamily HYPOGASTRURINAE Börner, 1906.

1. Postantennal organ absent. Ocelli, 5 or 4 on each side. Empodial appendage absent. Furca more or less reduced. Anal spines 2, usually very small.

   Genus XENYLLA Tullberg, 1869.

   Postantennal organ present.[1] 2

2. Postantennal organ simple, elliptical or indistinctly lobed. Empodial appendage absent. Anal spines absent or present.

   Postantennal organ compound with peripheral lobes. 3

3. Ocelli absent. Postantennal organ simple, cordate. Mandibles without proximal portion, basally with a pair of hooks. Head dorsally with a pair of curved spines or hooks. Anal spines 2, as long as the claws. Empodial appendage absent.

   Genus *Gomphiocephalus* Carpenter, 1908 (not Australian).

   Ocelli present. Mandibles normal. Empodial appendage absent. Anal spines absent.

   Genus *Schöttella* Schäffer, 1896 (including *Beckerella* Axels, 1912) (not Australian)

4. Furca poorly developed. Ocelli absent. Postantennal organ with 4-6 lobes. Empodial appendage present. Anal spines 2, very small, often absent.

   Genus *Willemia* Börner, 1901 (not Australian)

   Furca well developed. Ocelli, 8 or fewer on each side. Postantennal organ with 4, seldom 7, lobes. Empodial appendage present or not. 5

5. Cuticle with large granulations. Furca well-developed but mucro small in relation to dens. Ocelli, 8 on each side. 6

   Cuticle smooth or with only fine granulations. Ocelli, 8 or fewer.

   Genus HYPOGASTRURA (Bourlet, 1839) Börner, 1906 (including subgenera *Schäfferia* Absolon, *Typhlogastrura* Bonet, *Mesachorutes* Stach, *Mesogastrura* Bonet, *Folsomiella* Bonet).

6. Anal spines 3, large and on large papillae. Empodial appendage rudimentary.

   Genus *Triacanthella* Schäffer (in New Zealand but not Australia).

   Anal spines small, 2. Empodial appendage well developed.

   Genus *Proxenyllodes* Denis, 1926 (not Australian)

(b) Mandibles entirely absent or without molar plate.

Subfamily ACHORUTINAE Börner, 1906

(c) Anal segment with undivided supra-anal valve, with or without furca.

Tribe PSEUDACHORUTINI Börner, 1906

1. Anal spines present, although sometimes hardly larger than the cuticular granules.

   Anal spines entirely absent. 4

2. Anal spines 4 or more, almost straight, papillae scarcely present.

   Genus *Polyacanthella* Schäffer, 1900 (not Australian).

   Anal spines 3, 1 behind 2 in front, occasionally 0 or 5, always curved and on distinct papillae. Furca reduced. Ocelli, 8 or fewer on each side. Empodial appendage absent.

   Genus FRIESEA Dalla Torre, 1875.

   Anal spines 2, sometimes small and little more than cuticular granules. Postantennal organ present. Ocelli, 5 on each side. 3

[1] Except in *Hypogastrura (Mesogastrura) coeca* Jonesco?

3. Empodial appendage present. Mucrones with normal lamellae Postantennal organ large, trilobed.
Genus *Xenyllodes* Axelson, 1903 (not Australian).

Empodial appendage absent. Mucrones with two consecutive lobes. Anal spines represented by two rather larger granules of the cuticle. Postantennal organ small, 4-lobed.
Genus ODONTELLA Schaffer, 1897.

4. Eight ocelli on each side. 8
Fewer than 8 ocelli on each side. 5

5. Postantennal organ present. Ocelli generally present. 6
Postantennal organ absent. Ocelli, 2 or 3. Empodial appendage absent. Mouth-parts reduced.
Genus *Paranura* Axelson, 1902 (not Australian).

6. Mouth-parts very much reduced. Maxillae styliform without teeth. Empodial appendage absent. 7
Mouth-parts not so much reduced. Head of maxillae with teeth, not styliform. Ocelli, 5 on each side or absent. Empodial appendage present. 8

7. Ocelli, 1 on each side. Postantennal organ trilobed. Furca very much reduced, dentes and mucrones not differentiated. White, elongate.
Genus *Stachia* Folsom, 1932 (not Australian).

Ocelli, 2 or 4 on each side. Postantennal organ 6-20 lobed. Colour, bluish-grey or bluish-white.
Genus *Micranurida* Börner, 1901 (not Australian).

8. Mandibles with only a curved apical tooth and a subapical lobe-like expansion. Postantennal organ with 13-15 lobes. Ocelli wanting.
Genus *Anuridella* Willem, 1906 (not Australian).

Mandibles with many teeth and no lobe. Ocelli, 5 on each side or absent. 9
Genus ANURIDA Laboulbene, 1865.

9. Furca very long and slender. Dens many times (seven) as long as mucro. Antennae 3 times as long as head. Male with abdomen VI. produced. Ocelli, 5 on each side. Postantennal organ absent.
Genus NEACHORUTES, n. gen.

Furca much shorter or absent, when present of normal length. Antennae scarcely, if at all, longer than the head. 10

10. Species of flattened form with prominent pleural areas. 11
Species of normal build. 12

11. Furca present. Ocelli, 8 on each side. Postantennal organ half-elliptical with numerous lobes. Empodial appendage absent. Cuticle marked in hexagons. Body segments with cross furrows.
Genus CERATRIMERIA Borner, 1906 (including *Linnaniemia* Philiptschenko, 1926).

Furca absent. Ocelli, 5 on each side. Postantennal organ circular with 12-13 lobes. Empodial appendage absent.
Genus *Platanurida* Carpenter, 1925 (not Australian, but occurs in New Zealand).

12. Mandibles absent. Ocelli, 8 on each side. Postantennal organ present or absent. Furca present or absent.
Genus BRACHYSTOMELLA Agren, 1903. (including *Guacharia* Jackson, 1927).

Mandibles present, styliform. Ocelli, 8 on each side. Postantennal organ present or absent. Furca present.
Genus PSEUDACHORUTES Tullberg, 1892.

(d) Anal valve 2-lobed, broad. Abdomen VI. relatively large. Body generally with segmental tubercles. Postantennal organ of numerous cutaneous tubercles or absent.

Tribe ACHORUTINI Börner, 1906.

1. Body covered with numerous spines.

Genus *Holacanthella* Börner, 1906 (in New Zealand, not Australian).

Body not as above. 2

2. Sides of thoracic and abdominal segments produced backwards in long processes.

Genus *Acanthanura* Börner, 1906 (not Australian, but known from New Zealand).

Not as above. 3

3. Head of maxillae as in *Anurida* with a large-toothed head and 2-3 finely-toothed lamellae as well as a basal erect lobe, seldom without these. 4

Head of maxillae needle-like, without teeth or lamellae, at most at the base as in 4 with a tooth-like lobe.

Genus ACHORUTES Templeton, 1835; Börner, 1906.

4. Abdomen VI. hidden under V. Postantennal organ present, of numerous clustered lobes.

Genus *Morulina* Börner, 1906 (not Australian)

Abdomen VI. visible from above, not hidden under V.

Genus *Protanura* Börner, 1906 (not Australian).

B. With pseudocelli. With or without furca. Antennae with 2-3 sensory clubs, sensory rods, with or without papillae and protective setae. Antennae IV. mostly with subapical groove, seldom with retractile knob. Ocelli absent. Postantennal organ mostly present and well developed.

Family ONYCHIURIDAE (Lubbock, 1867) Börner, 1913.

1. The 2 or 3 sensory clubs of antennal organ III. smooth, curved towards one another, often an accessory club ventrally about the middle of the segment Ant. IV. with typical olfactory hairs. Postantennal organ with numerous simple lobes. Empodial appendage absent or bristle-like. Furca absent. Body long and narrow. 2

The 2 sensory clubs on antennal organ III. smooth or tuberculate, not curved towards one another. Postantennal organ of few or many simple or clustered tubercles or absent. Empodial appendage generally well developeed. Furca present or absent or rudimentary. Body broader and more robust. 3

2. Pseudocelli on body segments in the form of a rosette lying in a pit.

Genus TULLBERGIA Lubbock, 1876,

Pseudocelli consisting of two unequal, slightly curved rods lying in a pit. Lightly chitinised, brownish species.

Genus *Paratullbergia* Womersley, 1930 (not Australian).

3. Furca present, well developed with distinct manubrium, dentes and mucrones. Anal spines 4. Postantennal organ absent.

Genus *Tetrodontophora* Reuter, 1882 (not Australian)

Furca, when present, quite rudimentary. Postantennal organ present. 4

4. Cuticle with large granulations. Pseudocelli few, without a ring of chitin. Empodial appendage with basal lamella. Anal horns strong on large papillae.

Genus *Kalaphorura* Absolon, 1901 (not Australian).

Cuticle with numerous pseudocelli with distinct chitinous rings. No large cuticular granulations. Postantennal organ with simple tubercles or grape-like clusters. Furca absent or when present very rudimentary. With 4, 2 or 0 anal spines.

Genus ONYCHIURUS Gervais, 1842; Börner, 1901.

BIBLIOGRAPHY.

This will be given at the end of Part II. of the paper, which will deal with the Entomobryoidea.

TWO NEW DANTHONIAS.

By A. B. Cashmore (Waite Agricultural Research Institute).
(Communicated by J. M. Black, A.L.S.).

[Read June 8, 1933.]

Danthonia Duttoniana, n. sp. Culmi 50-60 cm. alti, robusti; folia angusta, 15-25 cm. longa, glabra; panicula sublaxa, 8-15 cm. longa, circa 5 cm. lata, ramis inferioribus 6-10 cm. longis, basin versus longe nudis; spiculae glomeratae, pedicellis 20-30 mm. longis, distantibus; glumae exteriores latae, 15-20 mm. longae; spiculae 5-9-flores, aristis glumas exteriores valde superantibus; pars basilaris glumae floriferae fusca, lata, 3-4 mm. longa, supra et subter annulo pilorum cincta; lobis lateralibus 6-10 mm. longis, pro dimidio eorum aristatis; arista centralis 14-17 mm. longa, infra geniculum brunnea et arcte torta; palea 7 mm. longa, acuta, emarginata, dorso glabra.

Mount Lofty Range; Victoria; New South Wales.

Differs from *D. semiannularis* in the larger and looser panicle, with numerous spikelets and the lower panicle-branches much larger and naked towards the base for about half their length. This species, mentioned as *D. Duttoniana* but not described by Mr. E. Breakwell in his "Grasses and Fodder Plants of New South Wales," p. 234 (1923), was named after Mr. J. Dutton, observer at the Bathurst Experiment Farm.

Danthonia Richardsonii, n. sp. Culmi 60-70 cm. alti, robusti; laminae foliorum 20-30 cm. longae, angustae, glabrae; panicula densa, 8-12 cm. longa, 2½-3 cm. lata, circa 70-spiculata, ramis erectis, inferioribus 1-4 cm. longis fere usque ad basin spiculis vestitis; spiculae 4-5-flores; glumae exteriores latae, 11-14 mm. longae; pars basilaris glumae floriferae 4 mm. longa, pilis subsparsis vel in seriebus verticalibus potius quam transversis, lobis lateralibus 4 mm. longis lanceolatis et brevissime aristatis; arista centralis 8 mm. longa, pallida, infra geniculum tantum semel torta; palea 4 mm. longa, obtusa, oblonga-cuneata, dorso glabra, laciniis villosa.

Werribee, Victoria.

Differs from *D. semiannularis* in the broader, denser panicle, the much shorter, pale-coloured and only once-twisted central awn, the shorter lateral lobes, and the scattered hairs of the flowering glume. Named after Dr. A. E. V. Richardson, first Director of the Waite Agricultural Research Institute.

English description in Comm. Aus. C.S.I.R. Bull., 69 (1932).

A REVISION OF THE EURYMELINI (HOMOPTERA, BYTHOSCOPIDAE).

By J. W. Evans, M.A., F.R.E.S.
(Division of Economic Entomology, Council for Scientific and Industrial Research.)

[Read June 8, 1933.]

Introduction.

Insects of the Eurymelini division of the Eurymelinae have attracted the notice of collectors in Australia since the earliest days of settlement, and for upwards of a century specimens have been sent to Museums in Europe for description by entomologists. Many of the descriptions were made from single specimens, with the result that synonyms are abundant, since the specific descriptions were largely based on colour characteristics, and with the majority of the known species the colouration is extremely variable.

Up to the present it has been the custom to place large individuals in the genus *Eurymela* Le P. & S. and the small ones in the genus *Eurymeloides* auctt., but for a long time it has been apparent that the classification of the group was in need of revision. The late Professor C. F. Baker had intended undertaking this work, and went so far as to prepare a tentative classification; this was never published. The revision presented here is based on a study of material examined in the collections of the British Museum; the Australian Museum, Sydney; the National Museum, Melbourne; the South Australian Museum; the Macleay Collection of the University of Sydney; the Froggatt Collection at Canberra, and the author's private collection. In addition, material has been lent by the Queensland Museum, and five paratypes of species described by Kirkaldy have been lent to the author by Mr. O. H. Swezey of the Hawaiian Sugar Planters' Association. The author is indebted to the authorities of these institutions for permitting him to examine the collections in their care. He also particularly wishes to acknowledge his indebtedness to Mr. W. E. China, of the British Museum, without whose ever ready help and advice he would have been unable to carry out this work. Mr. China permitted full use to be made of a tentative key to the Eurymelinae genera, (MSS.), prepared by him in 1926, and also furnished descriptions and drawings of type material in the British Museum collection.

Systematics.

The Eurymelinae are considered to be a division of the Bythoscopidae on account of the facial position of the ocelli. Further research may show that they merit elevation to family rank. In a paper published in 1926, China[1] considered the Pogonoscopini as a sub-family; here they are classed as a tribe. In addition to insects allied to *Pogonoscopus* spp. and *Eurymela* spp., there exist in Australia a number of genera similar to those mentioned above in having the ocelli facially placed. They also resemble them in habits and general appearance, but they lack the typical Eurymeloid colour pattern and differ in the structure of the genitalia. These insects are provisionally placed in the Ipoini. The three tribes of the sub-family Eurymelinae may be separated by means of the following key:—

(1) China, W. E., Trans. Ent. Soc., London, 1926 (2), 289.

1. Tegmina, a shiny blue, black, or brown colour, with or without white or coloured fasciae; sub-genital plates broad and flap-like, with styles. 2
Tegmina, hyaline or more or less transparent; if coloured brown or black, then without definite fasciae, and lacking the typical Eurymeloid colour-pattern; sub-genital plates long and narrow, without styles. .. .. IPOINI

2. Head, including the eyes, narrower than the pronotum at the base; hind-tibiae rounded in section with the outer sides flattened, and bearing a regular armature of spines arising direct from the tibiae themselves. .. .. POGONOSCOPINI
Head, including the eyes, wider than the pronotum at the base; hind tibiae quadrilateral in section, bearing distinct spurs with modified spines at their apices. .. EURYMELINI

This paper is concerned only with the Eurymelini; the Ipoini will be dealt with at a future date. The Pogonoscopini[2] have already been revised by China (1926). Among the Eurymelini examined were many single specimens representative of new species. These will not be described until further material is available.

KEY TO THE GENERA OF THE EURYMELINI.

1. Tegmen with four or five large and distinct apical cells; appendix well developed; hind tibial armature variable. 5
Tegmen without distinct apical cells, usually reticulate apically, or with eight or nine apical cells partially developed; appendix small; hind tibiae with one to three distinct spurs[3] 2

2. Head in profile evenly convexly rounded or globose. 3
Head in profile not evenly convexly rounded or globose, the frons being produced into a transverse spade-shaped process in the middle, which is concave dorsally.
EURYMELOPS Kirkaldy
Genotype *Eurymela rubrovittata* A. & S.

3. Head in profile evenly convexly rounded, not globose; tegmina, when closed, strongly tectiform 4
Head in profile strongly globosely convex; tegmina when closed not strongly tectiform, the clavus more or less horizontal and in the same plane as the pronotum and scutellum. .. .. PLATYEURYMELA, gen. nov.
Genotype *Eurymela semifascia* Walker

4. Tegmina, black or brown with or without whitish fasciae; femora of fore legs with four to six pairs of short blunt spurs on their interior margins; hind tibiae with one spur. .. .. EURYMELA Le P. & S.
Genotype *Eurymela fenestrata* Le P. & S.
Tegmina, black with one or two whitish fasciae, if two, the anterior one very large and the posterior one small, usually reticulate apically, occasionally with large apical cells; femora of fore legs spurless; hind tibiae with two, occasionally three spurs.
PAUROEURYMELA, gen. nov.
Genotype *Eurymela amplicincta* Walker

5. Front and middle femora spineless; hind tibiae with three to five distinct spurs decreasing in size from the apex of the tibiae to the base. 6
Front and middle femora with strong outwardly-curved spines (front with one, middle with three spines); hind tibiae with two distinct spurs on the apical half, and several feeble ones towards the base. .. .. EURYMELITA, gen. nov.
Genotype *Eurymela terminalis* Walker

6. Hind tibiae with three to five distinct spurs; sub-genital plates with distinct styles.
EURYMELOIDES Kirkaldy
Genotype *Eurymela bicincta* Erichs.
Hind tibiae with two distinct spurs and numerous spines; sub-genital plates with only a very slight development of a style .. .. EURYMELESSA, gen. nov.
Genotype *Eurymeloides moruyana* Distant

(2) All the representatives of this tribe, so far described, have been collected in Western Australia. In the South Australian Museum are specimens from Kangaroo Island, South Australia, and Victoria.

(3) These spurs are not homologous with those that occur on the hind tibiae of the Cercopidae, but are actually the enlarged bases of mobile spines.

EURYMELA Le Pelletier and Serville.

Encyc. Meth. 10; 604, 1825.
Signoret, Ann. Soc. Ent. Fr. (2) viii.; 503, 1850.

Signoret divided this genus into two sections, but did not name them. Since the genus as it now stands comprises only a few of the many species originally included in it, a redescription is given below.

Wedge-shaped insects, 6-14 mm. in length (from the apex of the head to the tip of the folded tegmina). The general colouration is brown or purplish-black, and the head in profile is evenly convexly rounded (fig. C, fig. 5). The venation of the tegmina is reticulate apically, and the hind tibiae have one distinct spur.

Twelve species have been described belonging to this genus as now defined; only three of these are recognised here, the others being considered as local races that differ in colour pattern and occasionally in size, but not in structure. One new species is described.

EURYMELA FENESTRATA Le P. & S. (Genotype).

**Eurymela fenestrata* Le P. & S., Encyc. Meth. 10; 604, 1825. **Eurymela ruficollis* Burm., Genera Insectorum, 1838-45. **Eurymela discoidalis* Sign., Ann. Soc. Ent. Fr. (2) viii.; 505, 1850. *Eurymela distincta* Sign., Ann. Soc. Ent. Fr. (2) viii.; 506, 1850. *Eurymela vicina* Sign., Ann. Soc. Ent. Fr. (2) viii.; 506, 1850. **Eurymela suffusa* Walk., List Homoptera iii.; 640, 1851. *Eurymela speculum* Walk., List Homoptera iii.; 641, 1851. **Eurymela plebeia* Kirk., H.S.P.A. Exp. Sta. Bull. 1 (9); 355, 1906. *Eurymela lubra* Kirk., H.S.P.A. Exp. Sta. Bull. 1 (9); 355, 1906. **Eurymela subnigricans* Dist., Ann. Soc. Ent. Belg. 52; 105, 1908.

A great number of varieties of this species exist, many of which have been given specific names. These varieties can be divided into two groups. One group comprises individuals in which the general colouration is bronze or brown; in the other group the predominating colour is black. Since no morphological differences can be discovered between the many varieties of both groups, and intergrades exist between them, they are best considered as comprising one species. There is, however, no doubt that *Eurymela fenestrata* as defined here contains a number of incipient species, any one of which, if isolated for a sufficiently long period, would probably acquire distinct structural characters. Separate descriptions for the two groups are given below. The synonyms marked * belong to the brown group, the remainder to the black group. Figure A is a diagrammatic representation of the tegmina of some of the varieties of the brown group. Although these forms are well established and not chance varieties, it is felt that it would only confuse their identification to give them specific rank, especially as there are certainly many more colour combinations than those figured here. The figures are drawn from individuals examined by the author, and were selected as showing the range of variation, and not as representing named varieties.

BROWN GROUP.

Description.—Length, 10 mm. (from the apex of the head to the tip of the folded tegmina). Head, entirely orange-rufous or very dark brown, or marked with a pattern containing both colours; maxillary plates always cream coloured. Pronotum and scutellum entirely apricot orange, orange rufous or dark purplish-brown, or marked with a pattern of orange and brown. Tegmen, with the anterior costal margin always rufous or yellowish, the rest of the tegmen dark brown or very dark purplish-brown, except for whitish fasciae which may be present; these vary in number from one to three, and though constant in position and size as far as the varieties are concerned, present numerous combinations within the group

and may be entirely absent (fig. A). Legs, coxae, and femora concolorous with the thorax; tibiae and tarsi black, excepting the proximal tarsal segment of the hind legs, which is white. Abdomen, ventral surface pale or dark ochreous; genital segments variable in colour, the lobes of the last ventral segment in the female long and narrow (fig. C, fig. 3). Male genitalia, sub-genital plates large and boat-shaped, having a long narrow style lying along the interior margin of the plate; the base of the style is attached to the thickened edge of the ventral margin of the plate; aedeagus as in figure (fig. B, fig. 1; fig. C, fig. 8).

Distribution.[4]—Queensland, New South Wales, Victoria and South Australia.

BLACK GROUP.

Description.—Length, 10-14 mm. Head, black, but for the maxillary plates, which are white or cream. Pronotum and scutellum, black. Tegmen, bluish or purplish-black, usually with one, two or three whitish fasciae; these, though constant in size and position as far as the varieties are concerned, present numerous combinations within the group and may be entirely absent; costal margin always black, never rufous or yellow. Legs, coxae, and proximal halves of femora scarlet (some museum specimens have yellow abdomens, it is not known whether this was their original colour); male and female genital segments black.

Distribution.—Queensland, New South Wales, Victoria, and South Australia.

NOTE.—There is a transitional form between the two groups which has all the colour characteristics of the black group, excepting that the anterior portion of the costal margin of the tegmen is rufous.

EURYMELA ERYTHROCNEMIS Burmeister.

Eurymela erythrocnemis Burm., Genera Insectorum, 1838-45.

Description.—Length, 8-9 mm. Head, black, maxillary plates broadly white. Pronotum, black, posterior margin white. Scutellum, black with apex rufous. Tegmen, black with the costal and claval margins broadly fulvous. Two white fasciae; anterior fascia strongly widened towards clavus across which it extends half way; posterior fascia arcuate, more or less parallel-sided, not much wider at costal margin than at apex of clavus. Legs, front and middle legs with coxae and proximal halves of the femora reddish, distal halves of the femora and tarsi black; hind coxae, femora and tibiae red, apices of tibiae and last two tarsal segments black, first tarsal segment white. Abdomen, ventral surface black, with a pallid spot in the middle of the last ventrite, and a small pale spot on the middle of each of the sub-genital plates (♂). Male genitalia, aedeagus as in fig. B, fig. 2.

Distribution.—New South Wales.

EURYMELA RUBROLIMBATA Kirkaldy.

Eurymela rubrolimbata Kirk., H.S.P.A. Exp. Sta. Bull. 1 (9); 354, 1906.

Description.—Length, 9 mm. Head, black, but for a narrow white border to the maxillary plates. Pronotum, either entirely black, or with the posterior half dull olive; the band of this colour being widest in the middle of the pronotum. Scutellum, black. Tegmen, bluish or bronzy black with the costal and claval margins fulvous; there are two whitish fasciae, the anterior irregular in shape, often narrow and transverse, the posterior transverse and always wider at the costal than at the hind margin of the tegmen. Legs, front legs, coxae, and proximal halves of femora reddish, distal halves of the femora, tibiae and tarsi black; middle legs entirely reddish but for the tarsi, and the distal halves of the

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[4] Distribution records refer to insects examined and do not necessarily indicate the limits of any species.

Fig. A.

Diagrammatic figures of the tegmina of insects belonging to the brown division of *Eurymela fenestrata*, to show the range of variation.

femora, which are black; hind legs entirely reddish, but for the distal quarters of the tibiae, which are black, and the first tarsal segment which is white. Abdomen, ventral surface black. Male Genitalia, aedeagus, as in fig. B, fig. 3.

Distribution.—New South Wales.

Eurymela bakeri, n. sp.

Description.—Length, 6-7 mm. Head, black, maxillary plates white. Pronotum, black, frequently the posterior margin is white. Scutellum, black. Tegmen, black, with the costal and claval margins fulvous, and having two white or grey fasciae; the anterior fascia is irregular in shape, frequently extending into the clavus, the posterior lunate, reaching transversely right across the tegmen, much wider at the costa than at the clavus. Legs, front and middle legs with the coxae and proximal halves of the femora reddish, distal halves of the femora, tibiae and tarsi black; hind legs entirely reddish-brown, but for the apex of the tibia which is black, and the first tarsal segment which is white. Abdomen, ventral surface black. Male genitalia, similar to those of *E. erythrocnemis*, the ventral outgrowth from the base of the aedeagus, differently shaped (fig. B, fig. 4).

Distribution.—New South Wales.

Type ♂ from Canberra, F. C. T., (12/30), in the collection of the Division of Economic Entomology, Council for Scientific and Industrial Research at Canberra. Described from a long series of males and females.

Platyeurymela, gen. nov.

Insects comprised in this genus may at once be recognised by being almost oval in outline when viewed from above (fig. C, fig. 1), and not wedge-shaped like those of related genera.

The head is globosely convex. The tegmina, which have their venation reticulate apically, are not strongly tectiform, but have the clavus more or less on a plane with the pronotum. The hind tibiae have one spur, and the front femora five or six pairs of very small spurs on the inner edge.

PLATYEURYMELA SEMIFASCIA Walker (Genotype).

Eurymela semifascia Walk., List Homoptera iii.; 643, 1851.

Eurymela tasmani Dist., Ann. Soc. Ent. Belg. 52; 106, 1908.

Description.—Length, 8 mm. Head, black, maxillary plates entirely black. Pronotum, black, hind margin narrowly white. Scutellum, black. Tegmen, black, costal and claval margins narrowly reddish; two narrow white fasciae, the anterior one on a level with the middle of the clavus and extending from very near the costal margin to the claval commisure; the posterior one on a level with the apex of the clavus and extending thence to the costal margin. Legs, fore and middle coxae, extreme base of anterior femora and proximal halves of middle femora, reddish-brown; anterior femora except base, distal halves of middle femora, tibiae and tarsi, black; hind legs with coxae and proximal halves of femora reddish, distal halves of femora, bases of tibiae and ultimate tarsal segment, black; tibiae except bases reddish, first two tarsal segments brownish-yellow. Abdomen, ventral surface black; posterior margin of penultimate segment, a spot on the middle of the two previous segments, and the ovipositor sheath, fulvous yellow. Male genitalia, aedeagus with the ventral lobe developed, the gonopore opening at the side (fig. B, fig. 5).

Distribution.—New South Wales, Victoria, and South Australia

Var. *tasmani* Distant.

Similar to the typical form, but the anterior white fascia on the tegmen broadened, and the inner half of the corium between the fasciae entirely white. The maxillary plates are entirely black as in *semifascia*. The male genitalia show slight differences, such as a narrower and more apically rounded ventral lobe of the aedeagus.

Distribution.—Tasmania.

PLATYEURYMELA ATRA Walker (fig. C, fig. 1).

Eurymela atra Walk., List Homoptera iii.; 645, 1851.

Description.—Length, 8 mm. Head, black, with a narrow white margin to the maxillary plates. Pronotum, black, with the hind margin narrowly white. Scutellum, black. Tegmen, dark brown, shading to black at the apex and the base of the clavus. Legs, fore and middle coxae and proximal halves of femora reddish-brown; distal halves of the femora, tibiae and tarsi, black; hind legs with coxae and proximal halves of the femora red, distal halves of the femora and the ultimate tarsal segment black; tibiae and the first two tarsal segments reddish-brown. Abdomen, ventral surface black, each segment having a brown posterior margin; sub-genital plates fulvous. Male genitalia, similar to those of *P. semifascia*, but with the apex of the aedeagus much broader, and the ventral process with a distinct bump on the side (fig. B, fig. 6).

Distribution.—Tasmania and South Australia.

Pauroeurymela, gen. nov.

This genus contains small species from four to six millimetres in length. The head in profile is evenly convexly rounded. The tegmina, while usually having the venation reticulate apically, occasionally have large distinct apical cells. The fore femora are spurless, and the hind tibiae bear from two to three spurs.

PAUROEURYMELA AMPLICINCTA Walker (Genotype).

Eurymela amplicincta Walk., Ins. Saund. Homopt. 84, 1858.

Description.—Length, 4-6 mm. Head, black, maxillary plates white. Pronotum, either black with the posterior margin narrowly white or olive, or entirely dull olive. Scutellum, black. Tegmen, black with a narrow fulvous margin; there are two transverse grey or pale yellowish-brown fasciae, the anterior very much larger than the posterior; the fasciae converge towards each other, being much closer together at the hind margin than at the costal margin of the tegmen. Legs, front and middle legs with the coxae and proximal halves of the femora red, distal halves of the femora, tibiae and tarsi, black; hind legs entirely red, but for the distal tarsal segment, which is black. Abdomen, ventral surface black. Male genitalia, the sub-genital plates are more or less rectangular; the opening of the gonopore is at the extremity of the aedeagus, not at the side; there is a spine at the posterior edge, and the anterior ventral process arising from the base of the aedeagus, is present (fig. B, fig. 11).

Distribution.—New South Wales.

Pauroeurymela parva, n. sp. (fig. C, fig. 2).

Description.—Length, 7-8 mm. Head, black, eyes dull brown; the vertex seen from above is angular. Pronotum, black, the posterior margin very narrowly reddish. Scutellum, black. Tegmen, black with a narrow fulvous edge to the costal and claval margins; there are two pale yellowish-brown fasciae, the anterior transverse and wide, narrower at the costal than at the hind margin of the tegmen

(When the tegmina are closed these two fasciae form a band right across the dorsal surface of the insect.) Posterior fascia, a very small triangular pale area lying against the costal margin of the tegmen. Legs, reddish, but for the fore tibiae, fore tarsi, tarsi of the middle pair of legs, and the distal tarsal segment of the hind legs, which are black. Abdomen, ventral surface black. Male genitalia, aedeagus with no anterior ventral process developed, but similar to that of the genotype in having a spine present on the posterior margin, and the opening of the gonopore at the extremity of the aedeagus (fig. B, fig. 12).

Distribution.—New South Wales.

Type ♂ from Katoomba, New South Wales (October 3, 1926); paratypes, two females from the same locality; type and one of the paratypes in the collection of the Australian Museum, Sydney.

EURYMELOPS Kirkaldy.

H.S.P.A. Exp. Sta. Bull. 1 (9); 350, 1906.

Kirkaldy defined *Eurymelops* as a sub-genus, it is here given generic rank. This genus comprises insects eleven to fourteen millimetres in length, which are brightly coloured, red being the predominant colour. The frons is produced into a transverse spade-shaped process; this process is concave dorsally, and hence the eyes from above appear very prominent (fig. C, fig. 6). The venation of the tegmen is reticulate apically, and the hind tibiae have two, occasionally three, spurs.

EURYMELOPS RUBROVITTATA Amyot & Serville (Genotype).

Eurymela rubrovittata A. & S., Hist. Nat. des Ins. Hemip., 555, 1843. *Eurymela rubrofasciata* Stal, Ofv. Vet.-Ak. Förh. 22; 156, 1865. *Eurymelops rubrovitta* Kirk., H.S.P.A. Exp. Sta. Bull. 1 (9); 354, 1906.

Description.—Length, 14 mm. Head, black, excepting the maxillary plates and a narrow band between the eyes, which are red. Pronotum, black, posterior margin red. Scutellum, black. Tegmen, small area along the anterior edge of

DESCRIPTION OF FIGURE B.

Figure 1	.. .. Aedeagus of	*Eurymela fenestrata.*
2	.. .. " "	*Eurymela erythrocnemis.*
3		*Eurymela rubrolimbata.*
4		*Eurymela bakeri.*
5		*Platyeurymela semifascia.*
6		*Platyeurymela atra.*
7		*Eurymelops bicolor.*
8		*Eurymelops rubrovittata.*
9		*Eurymelops latifascia.*
10		*Eurymelops generosa.*
11		*Pauroeurymela amplicincta.*
12		*Pauroeurymela parva.*
13		*Eurymeloides pulchra.*
14		*Eurymeloides bicincta.*
15		*Eurymeloides marmorata.*
16		*Eurymeloides punctata.*
17		*Eurymeloides lineata.*
18		*Eurymeloides walkeri.*
19		*Eurymeloides minutum.*
20		*Eurymeloides perpusilla.*
21		*Eurymeloides adspersa.*
22		*Eurymelessa moruyana.*
23		*Eurymelessa froggatti.*
24		*Eurymelita terminalis.*
25		Sub-genital plates, styles (s) and parameres (p.), of *E. terminalis.*

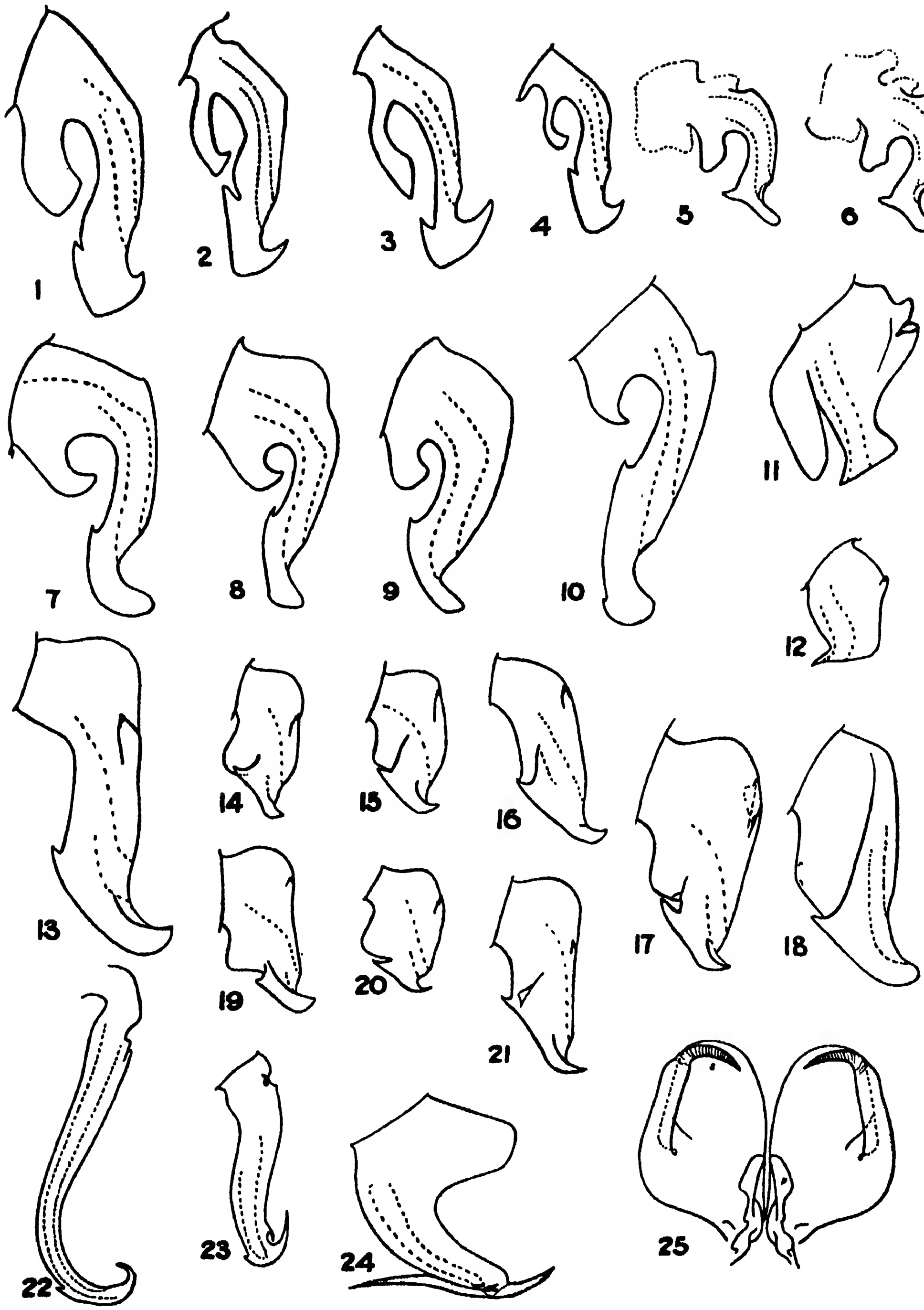


Fig. B.
[For description see opposite page]

the costal margin, and two transverse fasciae, red; the anterior fascia is sinuate; the rest of the tegmen is black, including the costal margin between the two fascia. Legs, coxae and proximal halves of the femora red; distal halves of the femora, tibiae and tarsi, black, excepting the first tarsal segment of the hind legs, which is white. Abdomen, red, genital segments black; the flap on the last ventral segment of the female, short and broad (fig. C, fig. 4). Male genitalia, sub-genital plates and parameres similar to those of *Eurymela* spp., aedeagus as in figure (fig. B, fig. 8).

Distribution.—New South Wales and Victoria.

EURYMELOPS BICOLOR Burmeister.

Eurymela bicolor Burm., Genera Insectorum, 1838-45. *Eurymela basalis* Walk., List Homoptera iii.; 640, 1851.

Description.—Length, 14 mm. Head, metallic blue or greenish-black, with the maxillary plates and the dorsal margin of the frons red, or the whole head entirely red. Pronotum, either entirely bluish or greenish-black, or black with the posterior margin red. Scutellum, bluish or greenish-black; in some specimens there is a red spot in the middle. Tegmen, entirely a metallic greenish or bluish-black with the anterior costal area red, or all the anterior half of the tegmen, but for a black spot on the clavus, red, and the posterior half metallic blue. These are the two commonest combinations of red and blue found in this species, but there are many others. Legs, usually entirely black, coxae and anterior halves of femora of fore legs occasionally red. Abdomen, ventral surface red. Male genitalia, aedeagus as in figure (fig. B, fig. 7).

Distribution.—Queensland, New South Wales, Victoria, and South Australia.

EURYMELOPS LATIFASCIA Walker.

Eurymela latifascia Walk., List Homoptera iii.; 639, 1851. *Eurymela pascoei* Dist., Ann. Soc. Ent. Belg. 52; 106, 1908.

Description.—Length, 11 mm. Head, ochreous, frequently with a black area in the middle of the frons, and another between the eyes. Pronotum, entirely black, black with a reddish posterior margin, or pale or dark ochreous, with an oval-shaped black area in each anterior corner. Scutellum, black. Tegmen, black, a basal area of varying extent ochreous, and with two red or reddish transverse fasciae which are joined along the costal margin of the tegmen by a narrow reddish or ochreous band, which widens anteriorly; the anterior fascia is the same width at both ends, while the posterior fascia is wider at the costal than at the hind margin of the tegmen. (The basal ochreous area is always connected to the anterior fascia along the fore border of the tegmen; the connecting red area may be narrow or wide.) Legs, coxae and proximal halves of femora ochreous; distal halves of femora, tibiae and tarsi, black. Abdomen, ochreous, frequently suffused with black. Male genitalia, aedeagus as in figure (fig. B, fig. 9).

Distribution.—Western Australia and South Australia.

EURYMELOPS GENEROSA Stal.

Eurymela generosa Stal, Ofv. Vet.-Ak. Förh. 22; 156, 1865. *Eurymela bunda* Dist., Ann. Soc. Ent. Belg. 52; 106, 1908.

Description.—Length, 14 mm. Head, entirely ochreous or reddish-testaceous, with bluish-black irregular markings on the frons and vertex. Pronotum and scutellum, bluish-black or testaceous, or marked with a combination of both colours. Tegmen, reddish-testaceous, with two transverse bluish-black fasciae that extend from the hind margin of the tegmen to close to the costal margin; these fasciae may be broken up into small irregular black areas, not forming a band; apical area of the tegmen, a hyaline brownish-ochreous. Legs, coxae and

proximal halves of femora red; distal halves of femora, tibiae and tarsi, black. Abdomen, ventral surface, reddish-testaceous; genital and anal segments black; sub-genital plates in the male with an oblique yellow stripe. Male genitalia, aedeagus as in figure (fig. B, fig. 10).

Distribution.—Western Australia.

EURYMELOIDES Kirkaldy.

H.S.P.A. Exp. Sta. Bull. 1(9); 354, 1906.

Eurymelias Kirk., H.S.P.A. Exp. Sta. Bull. 3; 29, 1907.

Eurymeloides Ashmead (Ent. Amer. 5; 126, 1889), is invalid, since it was described without reference to a species. By his action in fixing *E. bicincta* Erichs. as genotype (1906), Kirkaldy validated the genus, which should thus be attributed to Kirkaldy and not to Ashmead. The establishment by Kirkaldy of a new genus *Eurymelias* with type *E. hyacinthus* was therefore unnecessary, and *Eurymelias* automatically becomes a synonym *Eurymeloides,* since *bicincta* and *hyacinthus* are generically identical.

This genus contains a larger number of species than the other genera, and comprises insects ranging in size from five to eleven millimetres. The head in profile is slightly convexly rounded, in some species almost flat, and the vertex seen from above is angular. The tegmen has distinct apical cells and a well-developed appendix. The hind tibiae have three to five distinct spurs decreasing in size from the apex of the tibia to the base. The male genitalia have large, broad sub-genital plates, with distinct curved styles, that lie along the ventral external margin of the plates, but are not covered by them. The aedeagus invariably has one or two spines on the side of the posterior edge, and no anterior ventral process.

EURYMELOIDES BICINCTA Erichson (Genotype).

Eurymela bicincta Erichs., Beitrag zür fauna v. V. D. L., Archiv. Naturgesch. 286, 1842. *Eurymeloides bicinctellus* Kirk., H.S.P.A. Exp. Sta. Bull. 1 (9); 352, 1906.

Description.—Length, 7 mm. Head, fuscous mottled with straminaceous, the vertex mostly black, or head entirely black. Pronotum, brown or black, with a narrow white posterior margin. Scutellum, brown or black. Tegmen, shiny black with two narrow white fasciae, the anterior stretching from the middle of the costa to just anterior to the apex of the scutellum (when the tegmina are folded); the posterior transverse and widest at the costal margin; in addition to the fasciae there may be some small white spots on the tegmina. Legs, coxae, femora, and first tarsal joint of hind legs, white, the rest black; hind tibiae with three spurs. Abdomen, ♂ ventral surface black, but for the posterior margin of each segment, which is white; ♀ ventral surface white, genital segments black. (There is a variety with the abdomen, coxae, and femora, scarlet.) Male genitalia, aedeagus as in figure (fig. B, fig. 14).

Distribution.—Queensland, New South Wales, Victoria, and South Australia.

EURYMELOIDES PULCHRA Signoret.

Eurymela pulchra Sign., Ann. Soc. Ent. Fr. (2) viii.; 508, 1850. *Eurymela discifera* Walk., List Homoptera iii.; 641, 1851. *Eurymeloides hyacinthus* Kirk., H.S.P.A. Exp. Sta. Bull. 1 (9); 351, 1906.

Description.—Length, 11 mm. Head, clypeus and vertex black, the latter with a median orange stripe; maxillary plates and lorae pale straminaceous; frons pale rose with a median black stripe; eyes orange-red. Pronotum, black, with two more or less oval orange areas; entirely black, or entirely orange. Scutellum, orange, with a round black spot lying against the anterior margin. Tegmen, black,

with two yellow, pink or whitish transverse fasciae; the anterior fascia is made up of two distinct pale areas that meet at the claval suture; these two anterior fasciae may be quite separate or absent altogether; posterior fascia narrowly wedge-shaped. Legs, coxae and proximal halves of femora pale rose, distal halves of the femora, tibiae and tarsi, black, but for the first tarsal segment of the hind legs, which is white; hind tibiae with five spurs decreasing in size from the apex of the tibia to its base, and numerous spines. Abdomen, pale greenish-yellow; genital segments, black. Male genitalia, aedeagus as in figure (fig. B, fig. 13).

Distribution.—Queensland, New South Wales, Victoria, and South Australia.

EURYMELOIDES LINEATA Signoret.

Eurymela lineata Sign., Ann. Soc. Ent. Fr. (2) viii.; 509, 1850. *Eurymela livida* Walk., List Homoptera iii.; 642, 1851. *Eurymela decisa* Walk., List Homoptera iii.; 643, 1851.

Description.—Length, 8-9 mm. Head, Black, external border of the lorae straminaceous; frons red, with a central longitudinal black stripe; eyes ferruginеous. (The head may be entirely yellow but for a black posterior border.) Pronotum, black, with a narrow white posterior margin, or almost entirely red. Scutellum, either all black, or black with a red apex. Tegmen, black, purplish-black or purplish-brown, with a posterior transverse wedge-shaped fascia, widest against the anterior border of the tegmen; veins anterior to the fascia, pale yellow, posterior to the fascia, black. (The veins may be faintly pale or black, and the fascia divided into two areas, a broad triangular area against the costal margin of the tegmen, and a small irregular area against the hind margin; the latter may be absent; the tegmina in some specimens are entirely black with no pale markings.) Legs, coxae and the proximal halves of the femora red; distal halves of the femora, tibiae and tarsi, black; hind tibiae with three spurs and numerous spines. Abdomen, ventral surface red, genital segments, bluish-black. Male genitalia, aedeagus as in figure (fig. B, fig. 17).

Distribution.—New South Wales, Victoria and South Australia.

EURYMELOIDES PUNCTATA Signoret.

Eurymela punctata Sign., Ann. Soc. Ent. Fr. (2) viii.; 511, 1850. *Eurymela trifasciata* Sign., Ann. Soc. Ent. Fr. (2) viii.; 512, 1850. *Eurymela ocellata* Sign., Ann. Soc. Ent. Fr. (2) viii.; 511, 1850. *Eurymela varia* Walk., List Homoptera iii.; 644, 1851. *Eurymeloides cumulosus* Kirk., H.S.P.A. Exp. Sta. Bull. 1 (9); 351, 1906. *Eurymeloides ornatus* Kirk., H.S.P.A. Exp. Sta. Bull. 1 (9); 352,

DESCRIPTION OF FIGURE C.

Figure 1 .. *Platyeurymela atra.*
„ 2 .. *Paurocurymela parva.*
„ 3 .. *Eurymela fenestrata,* ventral view of apex of abdomen of female, to show overlapping lobes of last segment.
„ 4 .. *Eurymelops rubrovittata,* ventral view of apex of abdomen of female.
5 *Eurymela fenestrata,* head in profile.
6 *Eurymelops rubrovittata,* head in profile.
7 *Eurymeloides nigra,* hind tibia.
8 *Eurymela fenestrata,* lateral view of male genitalia; sp., sub-genital plate; p., paramere; a., aedeagus; s., style.
9 *Eurymelita terminalis,* lateral view of male genitalia; lettering as in fig. 8.
10 *Pogonoscopus myrmex,* lateral view of male genitalia; lettering as in fig. 8.
11 *Eurymeloides rubrivenosus* of Kirkaldy, aedeagus.
12 *Eurymeloides rubrivenosus* of Kirkaldy, sub-genital plate and paramere, (p.).
13 *Eurymeloides froggatti,* sub-genital plate, style (s.) and paramere (p.).
14 *Ipo pellucida,* sub-genital plate and paramere (p.).
15 *Ipo pellucida,* aedeagus.
16 *Lasioscopus acmaeops,* sub-genital plate, style, (s.) and paramere, (p.).

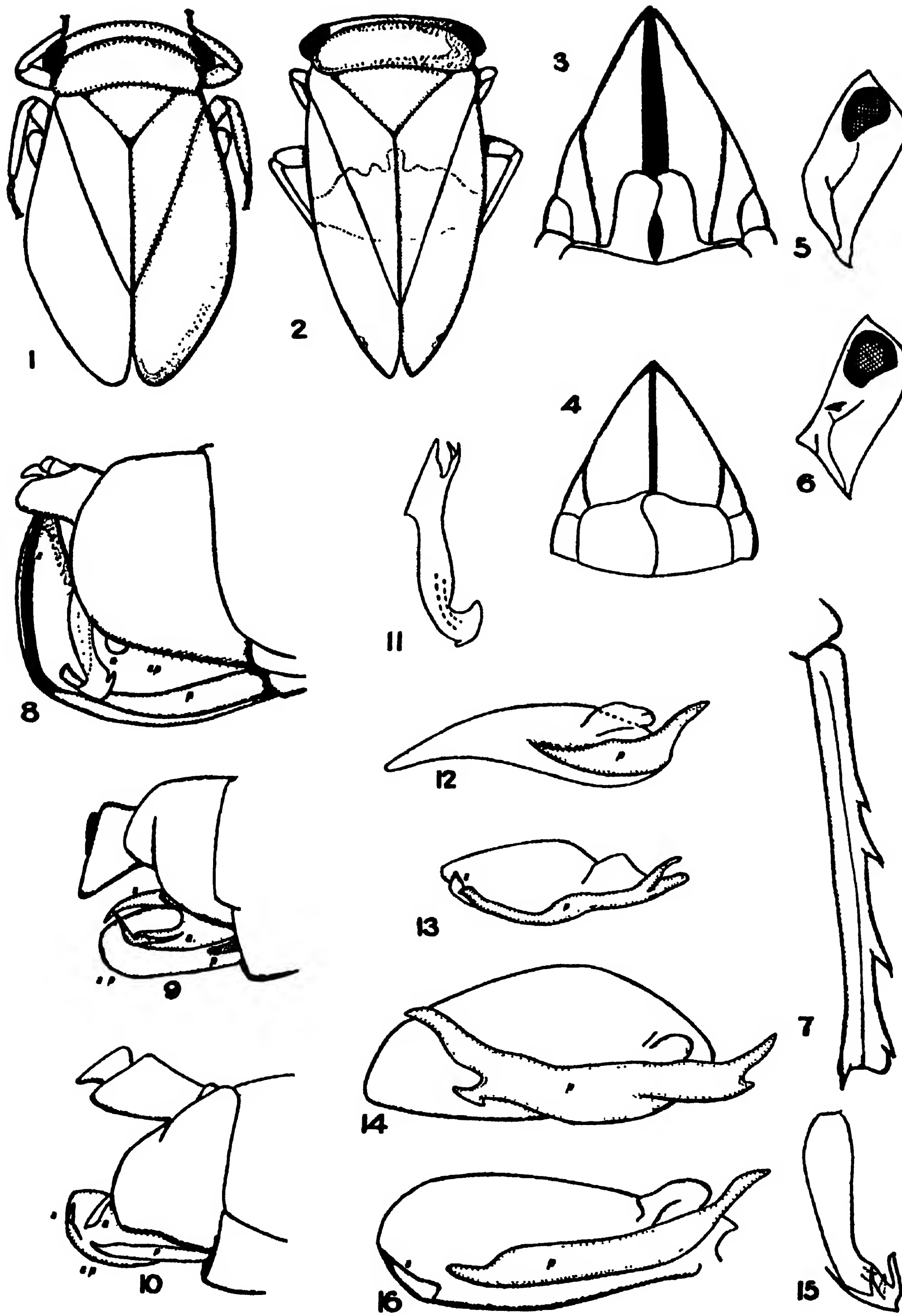


Fig. C.
[For description see opposite page]

1906. *Eurymeloides testaceus* Dist., Ann. Soc. Ent. Belg, 52; 101, 1908. *Eurymeloides atromaculatus* Dist., Ann. Soc. Ent. Belg. 52; 103, 1908.

This species, as the synonymy suggests, is a very variable one, and were it not for the large amount of material examined which showed transitional forms between the named varieties, would have been treated as several species. From the material available, forty-four specimens were selected, of which no two were identical; the genitalia of a number of these were examined, but no appreciable differences discovered.

Description.—Length, 6-8 mm. Head and pronotum, black mottled with yellow, pale brown mottled with yellow, or dark brown mottled with white; eyes reddish-brown. Scutellum, similar to pronotum, or with black or brown markings, or all black or all brown. Tegmen, usually black, but may be pale or dark brown; there may be two complete whitish fasciae, the anterior oblique and the posterior transverse; either of the fasciae may be incomplete, and have black or brown areas of varying shape in the middle of them; there may be a third transverse fascia between the other two; the fasciae may be an opaque white or merely semi-transparent areas of the tegmen; in nearly all the varieties examined the distal termination of the two anal veins have been white; the clavus may be dotted with white or light brown spots. Legs, coxae and femora light brown; tibiae and tarsi dark brown, excepting the first tarsal segment of the hind legs, which is white, and the spurs and spines on the hind tibiae which are white or yellow; hind tibiae with five spurs. Abdomen, ventral surface very pale brown or yellow, occasionally scarlet (this latter colour is found in aberrant forms of many species); genital segments dark brown or black. Male genitalia, aedeagus as in figure (fig. B, fig. 16).

Distribution.—Queensland, New South Wales, Victoria, and South Australia.

Eurymeloides perpusilla Walker.

Eurymela perpusilla Walk., Ins. Saund. Homopt. 83, 1858.

Description.—Length, 6 mm. Head, maxillary plates and lorae yellow; the clypeus, frons and vertex, black; eyes, greyish-yellow. Pronotum and scutellum, black mottled with yellow. Tegmen, black with two bright yellow fasciae; the anterior extending from the base of the tegmen to beyond the middle of the costal margin (not transverse but longitudinal), the posterior transverse and widest against the costal margin. In addition to two distinct fasciae there may be a number of yellowish or whitish spots on the tegmen, and the posterior fascia may be broken up into a number of irregular pale areas. Legs, coxae and proximal halves of the femora yellow, distal halves of femora and tarsi black; tibiae black with yellow spines; hind tibiae with three spurs. Abdomen, ventral surface black. Male genitalia, aedeagus as in figure (fig. B, fig. 20).

Distribution.—Queensland and New South Wales.

Eurymeloides marmorata Burmeister.

Eurymela marmorata Burm., Genera Insectorum, 1838-45. *Bythoscopus nigro-aeneus* Walk., List Homoptera iii.; 867, 1851. *Eurymeloides zonatus* Dist., Ann. Soc. Ent. Belg. 52; 104, 1908.

Description.—Length, 7 mm. Head, black, mottled with light or dark brown. Pronotum, light brown mottled with black and dark brown. Scutellum, black, frequently with pale markings on the posterior half. Tegmen, black or brown, with two indistinct yellowish or reddish transverse fasciae; in addition there may be a number of small pale markings between and on both sides of the fasciae; these may be so numerous that much less than half the total area of the tegmen is black or brown. Legs, coxae and femora yellowish or reddish-brown; tibiae

dark brown with pale spots, hind tibiae with three spurs. Abdomen, ventral surface pale brown or reddish-brown; genital segments pale brown. Male genitalia, aedeagus as in figure (fig. B, fig. 15).

Distribution.—Queensland, New South Wales, Victoria, and South Australia.

EURYMELOIDES ADSPERSA Signoret.

Eurymela adspersa Sign., Ann. Soc. Ent. Fr. (2) viii.; 510, 1850.

Description.—Length, 9 mm. Head, pronotum, and scutellum, black, mottled with reddish-brown and yellow; eyes greyish-brown. Tegmen, black with yellowish and whitish irregular markings arranged in the form of three indistinct fasciae; the claval area dotted with white spots. Legs, coxae and femora pale brown; tibiae dark brown with yellowish spots; hind tibiae with three spurs. Abdomen, ventral surface yellow; genital segments very dark brown. Male genitalia, aedeagus as in figure (fig. B, fig. 21).

Distribution.—Tasmania and Victoria.

EURYMELOIDES WALKERI Distant.

Eurymeloides walkeri Dist., Ann. Soc. Ent. Belg. 52; 102, 1908.

Description.—Length, 7·5 mm. Head, bright egg-yellow, vertex largely black except for the lateral margins; a median longitudinal stripe and a small spot on each side near the edge of the pronotum, which are bright yellow; middle of frons and clypeus black. Pronotum, bright yellow, with a large black spot behind each eye and a pair of longitudinal black stripes in the middle. Scutellum, black with the apex and markings on the disc yellow. Tegmen, shiny black, with an irregular arcuate spot on the corium anteriorly, a wedge-shaped white spot on the costa posteriorly extending half-way to the apex of the clavus, and a pair of small white spots between the apex of the wedge-shaped spot and the apex of the clavus; claval suture with a long percurrent white stripe, a small arcuate white band extending from the claval suture inwards towards the apex of the scutellum at a level slightly anterior to the fascia on the corium; three small white spots on the clavus, one at the apex of each of the claval veins, the other slightly beyond the inner end of the claval fascia, on a level with the apex of the scutellum. Legs, coxae, basal halves of femora, and apices of hind femora, yellow, the rest of the legs black, except for the first segment of the hind tarsi, a row of spots down the outer edges of the tibiae and the bases of the hind tibial spines, which are yellowish-white. Abdomen, ventral surface bright yellow, sub-genital plates in male shining black; sides of the ninth segment in the female black; disc of penultimate segments in both sexes somewhat infuscate. Male genitalia, aedeagus as in figure (fig. B, fig. 18).

Distribution.—Western Australia (Albany).

Eurymeloides minutum, n. sp.

Description.—Length, 5 mm. Head, black, mottled with yellow and brown; vertex as seen from above convex, not angular. Pronotum, black, with a few scattered small yellow spots. Scutellum, entirely black. Tegmen, hyaline, very dark shiny brown in colour with two white fasciae, the anterior divided into two more or less oval parts, both lying in the costal area; the posterior, an irregular transverse fascia, interrupted near the middle; it is wider at the anterior than at the posterior border of the tegmen; the claval area has a number of small yellow spots on it, and there are a few larger round yellow spots along the costal margin. Legs, coxae and femora pale yellowish-brown; tibiae and tarsi dark brown with white spots at the bases of the spines; proximal tarsal segments of hind legs, white; hind tibiae with three spurs. Abdomen, very dark brown; genital segments

of female pale brown, of male dark brown. Male genitalia, aedeagus as in figure (fig. B, fig. 19).

Type, ♀ from Matcham, near Gosford, New South Wales (March 27, 1924), paratype ♂ from the same locality; both specimens in the collection of the Australian Museum, Sydney.

Eurymeloides nigra, n. sp.

Description.—Length, 10 mm. Head, black, but for the external margins of the lorae, the external borders of the maxillary plates and the sides of the frons, which are white; eyes, scarlet. Pronotum and scutellum, black. Tegmen, black, with a single transverse posterior wedge-shaped white fascia, widest at the costal margin. (Paratype, with a small circular anterior fascia.) Legs, black, hind tibiae with three spurs (fig. C, fig. 7). Abdomen, ventral surface, the anterior three visible segments black anteriorly, pale brown posteriorly, the remaining segments black.

Distribution.—New Guinea.

Type, ♀ from Bisiatabu, Port Moresby, New Guinea. Paratype ♀ from the same locality. Both specimens in the collection of the South Australian Museum.

Eurymelessa, gen. nov.

This genus can be separated from Eurymeloides, which it somewhat resembles, principally by the characters of the male genitalia. The styles on the sub-genital plates are rudimentary (fig. C, fig. 13), and the aedeagus is longer and narrower than those of Eurymeloides spp. (fig. B, figs. 22 and 23). The head is slightly sub-angularly produced, and is inclined at a steep angle to the rest of the body, the maxillary plates are very broad. The venation of the tegmina is not reticulate apically, and the appendix is well developed. The hind tibiae have two spurs and numerous spines.

EURYMELESSA MORUYANA Distant (Genotype).

Eurymeloides moruyana Dist., Ann. Nat. Hist. 20; 188, 1917.

Description.—Length, 6·5-7 mm. Head, black with the posterior margin of the vertex moderately pale brown. Pronotum, entirely pale brown. Scutellum, black. Tegmen, dark brown shading to black apically; an oblique stripe across the middle of the corium from the claval suture to the costa; the costal edge, most anterior, and apices of the two anal veins, yellow or white; two apical white spots on the corium, one at the apex of the clavus, the other on the costal margin, at the same level; clavus sometimes entirely pale yellow. Legs, brown, last segment of the hind tarsi fuscous. Abdomen, ventral surface yellow. Male genitalia, sub-genital plates with rudimentary styles (fig. C, fig. 13); aedeagus long and narrow (fig. B, fig. 22).

Distribution.—Queensland and New South Wales.

Eurymelessa froggatti, n. sp.

Description.—Length, 6 mm. Head, black, or black with a pale brown crown; eyes, reddish-brown. Pronotum, either entirely pale brown, or entirely black. Scutellum, black. Tegmen, with one incomplete whitish apical fascia, or a number of small white apical spots; clavus and claval border of the corium, often largely dirty yellow. Legs, brown, last segment of hind tarsi black. Abdomen, ventral surface black, with the posterior margins of the segments narrowly pale brown. Male genitalia, aedeagus as in figure (fig. B, fig. 23).

Distribution.—Queensland, New South Wales, and Victoria.

Type, ♂ in the collection of the South Australian Museum. Described from a long series of males and females.

Eurymelita, gen. nov.

This genus contains a species very similar in general appearance to insects belonging to the genus Eurymeloides. The head, in profile, is almost flat. The tegmina have large, distinct apical cells and a well-developed appendix, and the front and middle femora have strong outwardly curved spines, the front with one and the middle with three spines. The hind tibiae have two distinct spurs on the apical half and several feeble ones towards the base. The male genitalia have very short parameres, and the sub-genital plates have a style arising from the dorsal edge, and not from the ventral edge as in all previous genera. (Fig. B, fig. 25, and fig. C, fig. 9).

The species described below is variable in colouration. Two main varieties exist, one with black tegmina and narrow pinkish-coloured fasciae, the other with brown tegmina and whitish fasciae. These varieties are connected by a series of transitional forms, but no morphological differences have been discovered between any of the many specimens examined.

Eurymelita terminalis Walker.

Eurymela terminalis Walk., List Homoptera iii.; 642, 1851.

Description.—Length, 9 mm. Head, usually all black, but for the maxillary plates, which are whitish; the latter may be pale chocolate colour and the frons have red markings on it, or the head may be entirely brown. Pronotum and scutellum, black with the hind margins chocolate or rufous; sometimes the chocolate colouration extends right over these sclerites; they may also be pale brown. Tegmen, black with two narrow white, cream or dull pink fasciae; the anterior one where it meets the hind margin of the clavus extends anteriorly towards the head, so that when the tegmina are closed, the anterior fasciae form an X; posterior fascia wider at the costal than at the hind margin of the tegmen; in some specimens the area of the tegmen anterior to the proximal fascia, is chocolate in colour, in others the whole tegmen, other than the fasciae, is pale brown. Legs, coxae and proximal halves of femora reddish-brown, distal halves of femora, tibiae and tarsi, black. Abdomen, ventral surface red, genital segments black. Male genitalia, sub-genital plates, parameres and aedeagus as in fig. B, figs. 24 and 25, and fig. C, fig. 9.

Distribution.—Queensland, New South Wales, Victoria, and South Australia.

Miscellaneous Notes.

The insects described under the following names have not been included in this revision, since they belong to the Ipoini.

Eurymela porriginosa Sign., Ann. Soc. Ent. Fr. (2) viii.; 512, 1850. *Eurymela lignosa* Walk., Homopt. Ins. Suppl. 166, 1858. *Eurymeloides lentiginosus* Kirk., H.S.P.A. Exp. Sta. Bull. 1 (9); 353, 1906. *Eurymeloides rubrivenosus* Kirk., H.S.P.A. Exp. Sta. Bull. 1 (9); 353, 1906. *Eurymeloides insignis* Dist., Ann. Soc. Ent. Belg. 52; 103, 1908.

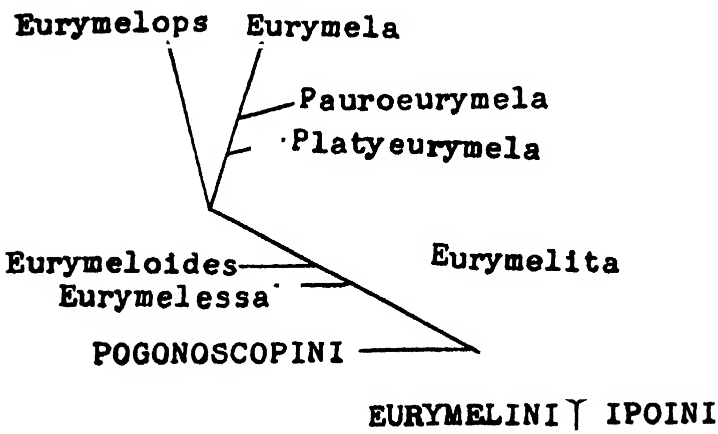
The following were originally placed in the genus *Eurymeloides* by Jacobi: *Pogonoscopus lenis* Jacobi and *Lasioscopus acmacops* Jacobi. (Jacobi, A., 1909, Faun. S.-W. Aust., Michaelsen u. Hartmeyer ii.; 340.) They were transferred by China (1926) to their present genera. Walker described two insects under the name of *Eurymela suffusa,* one in 1851 (= *fenestrata* Le. P. & S.), the other in 1858 (Ins. Saund. Homopt. 83); the last-named description is vague and the type is lost, consequently this species cannot be identified with any certainty. In addition to the above, two other insects have at some time been referred to the genus *Eurymela;* one is *Olonia maura* F. (Ent. Syst. iv.; 40, 1794), which apparently both Signoret and Distant understood to be a *Eurymela* sp.; the other is *Dardus abbreviatus* Guer., of which a synonym was described under the name

of *Eurybrachys laeta* White (Eyre Exped. 1; 433, 1845), and subsequently this name was quoted by Kirkaldy (H.S.P.A. Exp. Sta. Bull. 1 (9); 356, 1906), as being that of a *Eurymela* sp.

CONCLUSIONS.

This paper has dealt only with the Eurymelini, which is a natural tribe and not an artificial grouping of unrelated genera. The Ipoini, on the other hand, will probably have to be split up into three or four divisions, since as at present defined, it contains a diverse assemblage of forms. Whilst as far as it is known, the Eurymelini are confined to trees of the genus *Eucalyptus,* the Ipoini are found on a wide range of trees and shrubs, including Casuarinas and Melaleucas, as well as Eucalypts.

Below is given a chart showing the possible relationships of the three tribes of the Eurymelinae, and the genera of the Eurymelini. The genera *Eurymelita* and *Eurymeloides,* while resembling each other superficially, are not actually closely related, hence in the chart, the former is shown as branching away from the main stem before the Pogonoscopini. It is considered that the original stem from which all three tribes arose, comprised insects with narrow sub-genital plates without any development of a style. While on one hand *Eurymelita terminalis* has developed styles arising from the dorsal edge of the sub-genital plates, the rest of the Eurymelini and the Pogonoscopini bear styles that arise from the ventral edge of the sub-genital plates.



For the purpose of comparison with the genitalia of the Eurymelini, figures are given of the male genitalia of certain of the Pogonoscopini and the Ipoini. Fig. C, figs. 11 and 12, show the aedeagus, sub-genital plates and parameres of *Eurymeloides rubrivenosus* of Kirkaldy (= *E. lentiginosus* of Kirkaldy). Not only is there no style, but the plate itself is narrow, and very dissimilar to those of the Eurymelini.

Figures 14 and 15 (fig. C) represent the aedeagus, sub-genital plates and parameres of *Ipo pellucida* F, and figures 10 and 16 (fig. C,) are of the male genitalia of *Pogonoscopus myrmex* China and *Lasioscopus acmaeops* Jacobi. With the two last-named species, which both belong to the Pogonoscopini, while the sub-genital plates are broad like those of *Eurymela* spp., the style is shorter and the aedeagus is a much simpler structure. The biology and general morphology of the Eurymelinae have been dealt with in an earlier paper by the present author. (Proc. Linn. Soc., N.S.W., 56 (3); 210-226, 1931.)

NOTES ON THE FLORA OF SOUTH AUSTRALIA—No. 1

(With a description of a new species)

By Ernest H. Ising.

[Read June 8, 1933.]

During a trip to the Far North of our State and to Central Australia in August and September of 1931 and 1932, I collected specimens of native plants in various localities. The following places were visited and collections made:—*Central Australia:* Horse Shoe Bend, August 22 to 25, 1931; Rumbalara, August 25, 1931; Finke Railway Station, August 22 and 25, 1931; Coglin and Wall Creeks, August 26, 1931; *South Australia:* Abminga, 9 miles from the border of Central Australia and on the Abminga Creek, August 26 to 31, 1931; Pedirka, on the Hamilton River, August 22, 1931, and August 30, 1932, to September 6, 1932; Hamilton Bore, August 28, 1932; Snake Gully, 16 miles south of Pedirka, September 1, 1932; Stevenson River, September 2, 1932; Blood's Creek, September 3, 1932; Dalhousie Springs, September 5 and 6, 1932; Macumba Head Station, September 1 to 6, 1931; and Oodnadatta, August 6 to 8, 1931.

The 1931 season was a very good one in the Far North, resulting in a profusion of wild flowers in most of the places visited; 1932 season was not so good from a botanical point of view. Mr. J. M. Black is reporting on the grasses and the species of *Swainsona* (Leguminosae) collected. A number of very interesting specimens were gathered, including a new species of *Bassia (B. Blackiana).* Additional information is given on a number of other species which are imperfectly known.

CHENOPODIACEAE.

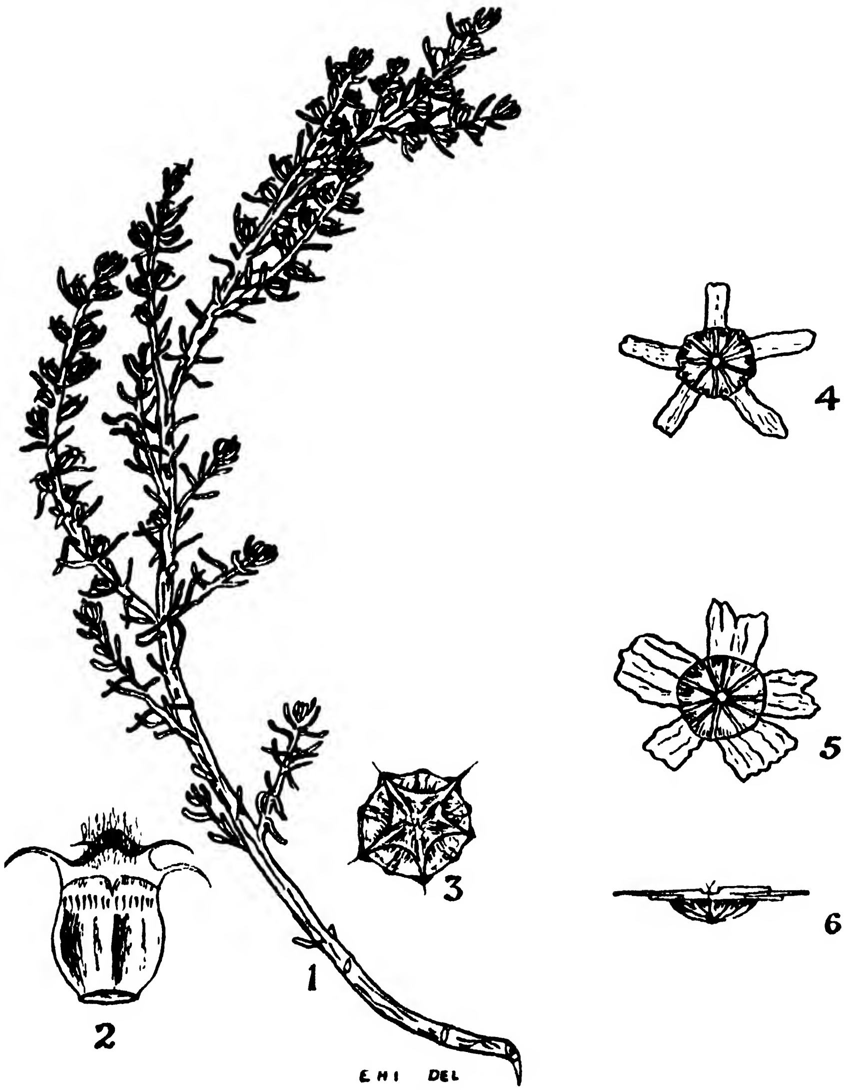
Bassia Blackiana, n. sp. Fruticulus ramosus, ramis rigidis albo-lanosis; folia erecto-patentia, saepius incurva, subteretia, 3-10 mm. longa, 1 mm. lata, hirsuta; flores solitarii in axillis superioribus conferti; perianthium fructiferum urceolatum, tubo globoso glabro circ. 2 mm. dia., 5-costato, areolâ orbiculari, planâ, omnino basilari, limbo erecto puberulo 1 mm. longo, spinis 5, recurvatis, inaequalibus, ½-1½ mm. longis glabris; semen oblique horizontale. (Figs. 1, 2 et 3, p. 92.)

Plant diffuse, 15 to 20 cm. high, branches ascending, numerous, woolly; leaves 3 to 10 mm. long by 1 mm. wide, subcylindrical but flat at base, hirsute when young and hairs tufted around the base; flowers solitary, axillary, densely placed; styles 2; fruiting perianth urceolate, glabrous, 2 mm. long x 2 mm. wide, often with 5 main longitudinal ribs formed by the decurrent bases of the spines and 5 other ribs alternating with them; base circular, very slightly oblique, about 1 mm. diameter; limb erect, conical, 1 mm. long, pubescent, with 5 ridges opposite to and extending to the spines; spines 5, irregular in length, the longest 1½ mm., 3 about 1 mm. long, the fifth ½ mm. long, recurved, reddish and glabrous; seed obliquely horizontal.

Oodnadatta, September 7, 1931. Type (No. 2,670) in author's collection.

This species differs from all others in the shape of the fruiting perianth. It appears to be nearest to *B. recurvicuspis* W. V. Fitzg., but this species only has 4 spines (occasionally 5, two of which are opposite one another) and the tube is cylindrical and smooth. *B. costata* R. H. Anderson has an obconical tube, as also has *B. parviflora* R. H. Anderson, which has 6 straight spines.

Named in honour of Mr. J. M. Black, A.L.S., author of "The Flora of South Australia" and "Naturalised Flora of South Australia." Mr. Black has been



DESCRIPTION OF FIGURE.

1, 2, 3. *Bassia Blackiana*, n. sp. 1. Fruiting branch; nat. size. 2. Fruiting perianth; x 10. 3. View of fruiting perianth from above showing position of spines; x 10. Oodnadatta, September, 1931. Collector, E. H. Ising, No. 2,670.

4, 5, 6. *Kochia scleroptera* J. M. Black. 4 and 5. View of a fruit from below after removal of hairs; x 6. 6. Side view of No. 5; x 6. Coglin Creek, C. Aust., August, 1931. Collector, E. H. Ising, No. 2,713.

a most energetic worker in systematic botany for many years and has named and described 3 new genera, 170 new species and over 70 new varieties of the flora of our State. Only one other plant has been named after Mr. Black and that is a grass *(Stipa Blackii)*, described by C. E. Hubbard of Kew Gardens, England.

B. ventricosa J. M. Black. The fruiting perianth sometimes has about 12 longitudinal ribs hidden by the vestiture, which is pilose to villous. The longest spines are up to 6 mm. long.

B. lanicuspis F. v. M. The leaves are up to 24 mm. long in a specimen from Abminga. The perianth is always densely hirsute and the base small and circular. Far North and Coglin Creek, Central Australia.

B. uniflora (R. Br.) F. v. M. Additional localities are:—*Central Australia:* Horse Shoe Bend and Coglin Creek.

B. intricata R. H. Anderson. The 5 spines, in a specimen (No. 2,663) from Wangiana, are strongly recurved. One from Macumba (No. 2,672) has the 5 spines more or less recurved, while No. 2,671, from the same locality, has straight spines which are practically horizontal.

B. eriacantha (F. v. M.) R. H. Anderson. Specimens from Abminga sometimes have the hairs on the fruits and leaves of a rusty colour.

B. echinopsila F. v. M. The leaves and stems, in a specimen from Oodnadatta, are sparsely pubescent while the perianth tube is glabrous, spines 6 with two of them joined at the base and mostly spreading.

B. Tatei F. v. M. Some specimens collected at Oodnadatta now take the known range of this species about 300 miles further north. The oblique base is often produced as high as the limb. This is an endemic species.

B. bicornis (Lindl.) F. v. M. This species was collected at Wall Creek, Central Australia, having fruits with 4 spines. The specimen collected had 38 fruits, 3 of which had 4 spines, 15 had 3 spines each and the remainder had the normal 2 spines each. This is the first record of fruits being discovered with 4 spines.

B. convexula R. H. Anderson. This species is now recorded from Central Australia, having been found at Horse Shoe Bend.

Kochia scleroptera J. M. Black. As no illustration of this species has previously been published, one is given on p. 92, figs. 4 to 6. The horizontal wings are completely hidden by the dense woolly vestiture of the fruit. The hairs have been removed from the fruits illustrated. An examination of the fruits has revealed a considerable variation in the size and shape of the individual wings which are always hard and rigid. The base of the fruit has 10 prominent longitudinal ribs. The species was described by Mr. Black in 1922 (These Trans., vol. xlvi., 568) and the localities given are all in our Far North. I have now to record the species from Central Australia as it was collected by myself at Coglin Creek close to our border.

DISTRIBUTION OF MYOPORACEAE IN CENTRAL AUSTRALIA.

By T. T. Colquhoun, M. Sc., University of Adelaide.

[Read July 13, 1933.]

This list makes no claim to being a complete digest of the *Myoporaceae*, either in species occurring in this region or their distribution. Professor J. B. Cleland, on his various trips to this area, collected many specimens of members of this family and suggested that I should identify and catalogue them. The present paper is the outcome of that suggestion. I wish to record my thanks to Professor Cleland for the use of his specimens; to Mr. J. M. Black for his help in establishing a new variety; and to the staff of the National Herbarium, Melbourne, for their aid and the specimens they placed at my disposal.

The following is a list of species and their distribution:—

MYOPORACEAE Benth. et Hook.

I. Myoporum Banks et Sol.—*M. montanum* R. Br.: Mount Ultim, Brinkley's Bluff, Palm Valley (Finke River), Hermannsburg. *M. deserti* A. Cunn.: Glen Helen (McDonnell Ranges).

II. Eremophila R. Br.—*E. Sturtii* R. Br.: Cockatoo Creek. *E. Latrobei* F. v. M.: Railway bridge over Finke River, between Hann's Range and Prowse's Gap, Cockatoo Creek, Mount Liebig. *E. Gilesii* F. v. M.: North of Burt Well, north of Hann's Range, Haast's Bluff. *E. longifolia* (R. Br.) F. v. M.: Bundey Creek, Fraser River, Hamilton Creek, Mount Hay, Brooke's Soak (30 miles east of Cockatoo Creek), Cockatoo Creek, Mount Liebig. *E. Battii* [1] F. v. M. var. *major* J. M. B.: Railway bridge over Finke River. *E. Freelingii* F. v. M.: Junction of Bundey Creek and Fraser River, Palm Valley, Hermannsburg, Mount Liebig. *E. Duttonii* F. v. M.: Fraser River, Burt Well, north of Woodforde Well, Brooke's Soak. *E. maculata* (Ker.) F. v. M.: Kerr's (on Bundey Creek), Claraville, Burt Well. *E. Dalyana* F. v. M.: Fraser River. *E. Christophori* F. v. M.: 40 miles north of Arltunga. *E. McDonnellii* F. v. M.: Rumbalare.

(1) At the time of reading this paper, Mr. Black had not published a description of *E. Battii* var. *major*; but had intentions of doing so in the near future.

CONTRIBUTIONS TO THE ORCHIDOLOGY OF AUSTRALIA.

By R. S. Rogers, M.A., M.D., F.L.S.

[Read August 10, 1933.]

Bulbophyllum Weinthalii, Rogers, sp. nov.

Planta pusilla. Rhizoma repens breve, radicibus fibrosis. Pseudobulbi utriculiformes, lateribus vix compressi, circa 9 mm. longi, 5-6 in serie. Folium singulare, planiusculum, subsessile, oblongo-ellipticum, glabrum, coriaceum, c. 1·5-2·5 cm. longum, 4-6 mm. latum, apice obtusum, marginibus integris, costa media prominente. Inflorescentiae ad basin pseudobulborum, pedunculo brevi. Flos solitarius, majiusculus, pedicello gracili c. 1 cm. longo. Segmenta perianthii alba vel subviridia, notationibus porphyreis vel purpureis instructa. Sepalum dorsale late lanceolatum, erecto-incurvum, concavum, c. 9 mm. longum, 5 mm. latum, apice acuta vel leviter apiculata. Sepala lateralia oblique falco-triangularia, semipatentia, sepalo dorsali aequantia vel paulum breviora, apice falcata, margine anteriore lunato, basibus pede columnae adnatis cum eo saccum vel humilem fossam formantibus. Petala erecta vel leviter divergentia oblongo-ovalia, apicibus obtusissimis, 3-nervia, c. 6 mm. longa, 3 mm. lata. Labellum mobile, linguiforme, magnum, conspicuum, carnosum, atropurpureum, cum apice pedis columnae articulatum, inferne ad pedem columnae reflexum, deinde valderecurvum; trilobatum, lobis lateralibus minutissimis dentiformibus, lobo medio obtusissimo marginibus revolutis; lamina in medio concava, callis duo latis longitudinaliter parallelis confluentibus prope apicem instructa. Columna brevis, alis membranaceis quadratis. Pes gynostemii elongatus, c. 1 cm. longus, gracilis, linearis, basibus sepalorum lateralium adnatus. Anthera opercularis; pollinia 4.

A diminutive plant with a short creeping rhizome and fibrous roots. Pseudobulbs flask-shaped, wrinkled, scarcely compressed laterally, about 6 in a row, 9 mm. high. Leaf apical on pseudobulb, single, rather flat, coriaceous, oblong-elliptical, subsessile, glabrous, margins entire, about 1·5-2·5 cm. long, 4-6 cm. wide, obtuse at apex, with very conspicuous midrib. Flower single, relatively large for size of plant; ovary-pedicel slender, about 1·0-1·1 cm. long; peduncle short. Perianth segments white or pale greenish, dotted or splashed with reddish-brown or magenta markings. Dorsal sepal rather widely lanceolate, erecto-incurved over the column, concave, apex acute or slightly apiculate, about 9 mm. long, 5 mm. wide; lateral sepals semi-patent, acutely falcate at the apex, obliquely falco-triangular, about equal to or a little shorter than the dorsal sepal; anterior margin crescentic; adnate throughout their entire base to the foot of the column for a distance of about 1·0 cm., forming with it a shallow pouch or trough. Petals erect or slightly divergent, oblong-oval, apices very blunt, 3-nerved, about 6 mm. long, 3 mm. wide. Labellum movable, articulated to the apex of the column-foot, large, linguiform, conspicuous, fleshy, dark purple, the lower part reflexed against the column-foot, then markedly recurved upwards and forwards; trilobed; the lateral lobes dentate, very minute; middle lobe very obtuse, with revolute margins; lamina dotted, concave in the middle, traversed by two wide parallel longitudinal calli coalescing near the apex. Column short and stout, with quadrate membranous wings; produced at the base into an elongated slender linear foot about 1·0 cm. long, adnate to the bases of the lateral sepals. Anther opercular, pollinia 4.

New South Wales. Dorrigo, Mr. F. A. Weinthal. Bloomed in cultivation, April, 1932. It was found growing "on the high branches and tops of pine trees."

This little plant would appear to be most closely related to *B. Baileyi,* F. v. M., which it nearly resembles in colour and shape of flowers. Mueller's plant, however, is enormously larger in all its parts and with very differently shaped leaves. The type description gives the measurements of the latter as 3-4 inches long and 1½-2 inches wide; the rhizome up to 6 feet long. Apart from the disparities referred to, the new species has an extraordinary long, slender linear column-foot. It is at least twice as long as the column proper. In Fitzgerald's drawing of *B. Baileyi* the foot is shown as rather stout and hardly as long as the column. It has been suggested that the plant under consideration is the southerly representative of the Queensland species, but the distinctions enunciated seem sufficient to dispose of this theory.

A PRELIMINARY ACCOUNT OF THE BDELLIDAE (SNOUT MITES) OF AUSTRALIA.

By H. Womersley, A.L.S., F.R.E.S., South Australian Museum.

[Read August 10, 1933]

Introduction.

While investigating the possibility of biological control of the Clover Springtail *(Sminthurus viridis* L.) in Western Australia during 1931-32 on behalf of the Commonwealth Council for Scientific and Industrial Research, the writer was successful in finding a species of Bdellid mite *(Biscirus lapidarius* Kramer) which, while occuring locally in a few districts, was present in such numbers as to be rapidly cleaning up the Sminthurids in those areas.

Besides this particular species of Bdellid many others were found in various parts, and while these did not appear to have any controlling effect on the Collembola, yet the family as a whole is well known to be predatory. The important discovery that at least one species may be of use in biological control has led the author, therefore, to make a thorough systematic study of the Australian species. In addition to his own captures he has had invaluable help from many other enthusiastic collectors in other parts of the country. To all these, and in particular to Mr. L. J. Newman, Government Entomologist of Western Australia, Mr. V. V. Hickman of the University of Tasmania, Hobart, and to Mr. D. C. Swan of the Waite Institute, Adelaide, he tenders his deepest thanks.

The result of the study of *Biscirus lapidarius* and its practical effect in controlling *Sminthurus* has been reported and discussed elsewhere (Jour. C.S.I.R., May, 1933). This paper deals with the specific and generic characters of all species now known to occur in Australia, and is intended to assist State Entomologists and others to recognise the individual species and so be able to distinguish the useful one. It should be borne in mind, however, that all species are predatory, and that under suitable conditions any of them may prove to be of value.

Hitherto, only *Bdella (Scirus) hospita* Banks has been recorded from Australia and described from specimens found in ants' nests in Victoria and Tasmania by Mr. A. M. Lea. Later on it is shown that this species is synonymous with *Biscirus symmetricus* Kramer.

General Description.

The mites belonging to this family of the Acarina are small, reddish to blackish, elongate, pear-shaped creatures, with a very pronounced beak and the body divided by a distinct separation into cephalothorax and abdomen. They are placed in the suborder Prostigmata because of the opening of the stigmata at the base of the mandibles. The mouth-parts consist of a cone-shaped rostrum furnished ventrally with a number of hairs, and a pair of dorsal mandibles, each of which carries a terminal pair of shears and dorsally one or more long hairs. The shears of the mandibles may or may not be armed internally with teeth. Immediately below the base of the mandibles arises a pair of five-segmented palpi. These are generally long and the second and fifth segments are usually much longer than the rest. The fifth segment may be parallel-sided or may be widened apically. At the apex of the terminal segment are to be found two or three long hairs, possibly of a sensory nature. The cephalothorax is trapezoidal in shape and dorsally carries 2, 4, or 5 eyes (seldom none), 4 characteristic long sensory hairs ("Pseudostigmalorgane"), 0, 2 or 4 other hairs and often subcutaneous shields

or lines. Ventrally are attached the front two pairs of epimera, and there are a few short hairs. The abdomen is approximately egg-shaped and is furnished dorsally with several rows of from 2 to 4 hairs or setae. Ventrally it carries the two posterior pairs of epimera, an anterior genital opening with hairs and three pairs of discs ("inneren Genitalnäpfen"), and a posterior anal opening.

There are four pairs (three in larva) of six-segmented legs, each tarsus being furnished with two strong claws and a medial hairy empodial appendage. On the tibia and tarsus are usually one or two long sensory setae. The hairs of the legs are of two kinds, simple and feathered.

The colour of the animals is generally reddish but sometimes varies to blackish. The pigment is entirely subcutaneous. The cuticle is very finely striated, striations being generally transverse but sometimes circular or zig-zag. Cross striations occur on the legs and palpi.

The sexes differ mainly in the structure of the genital organs, but occasionally differences are to be found in the relative lengths of the palpal segments, etc.

The immature stages are but little known and have been described for only a few species. The eggs are slightly elliptical and furnished with a number of clavate chitinous spines. They are brownish and laid on the ground or decaying vegetable fibres. The larvae much resemble the adults, except that they have only three pairs of legs and no genital organs. The nymphs are even more like the adults although still lacking the genitalia.

Australian Species.

Of the many species known to science, mainly from the temperate parts of the world, the following only have as yet been found in Australia:—

Cyta latirostris (Herman); *Bdella lignicola* Can.; *Scirus longirostris* Herman; *Scirus dubitatus*, n. sp.; *Biscirus (Biscirus) lapidarius* (Kramer); *B. (B.) sylvaticus* (Kramer); *B. (B.) intermedius* Sig. Thor.; *B. (B.) symmetricus* (Kramer); *B. (B.) uncinnatus* (Kramer); *B. (B.) australicus*, n. sp.; *B. (B.)*

Description of Figure A.

Fig. 1. *Cyta latisrostris* (Herm.). Mandibles and palp (after Berlese).
" 2. " " " Dorsal view of animal (after Berlese).
" 3. *Bdella lignicola* Can. Rostrum, ventral view.
4. " " " Palp.
5. Dorsal view of entire animal.
6. Mandible
7. Cephalothorax from above.
8. Tarsus.
9. *Scirus longirostris* Herm. Mandible.
10. " " " Palp.
11. " " " Tibia and tarsus.
12. " *dubitatus*, n. sp. Mandible.
13. " " " " Subcutaneous shield of cephalothorax.
14. " " " " Palp.
15. " " " " Tarsus.
16. *Biscirus hickmani*, n. sp. Cephalothorax.
17. " " " " Mandible.
18. " " Tarsus.
19. " " Palp.
20. " " Tip of tarsus and claw.
21. *lapidarius* (Kramer). Dorsal view.
22. Female genital organ, exserted.
23. " " " withdrawn.
24. Genital organ, male.
25. Larva, dorsal view.
26. Rostrum of larva.
27. " " " Mandible of larva.

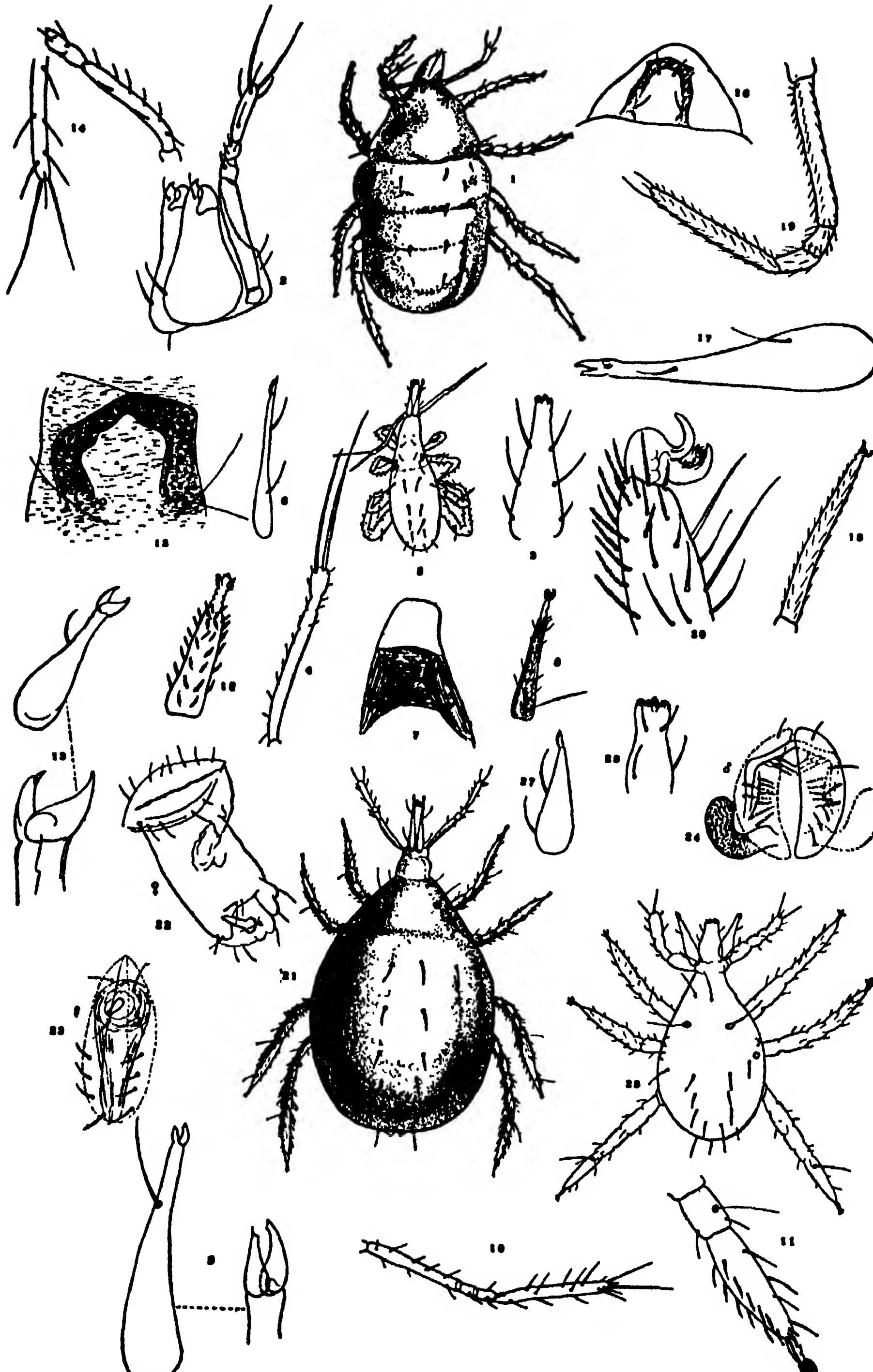


Fig. A. For description see opposite page.

thori, n. sp.; *B. (B.) hickmani*, n. sp.; *B. (Odontoscirus) virgulatus* (Can. et Fanz.).

Of these 13 species, 4 are new to science, the remainder being indistinguishable from European forms. The genera *Trachymolgus* and *Spinibdella* are as yet unknown from this continent, and the genus *Bdella* is only represented by one species. The last genus, however, may be largely increased, both by native and introduced forms.

In working up the systematics (as shown below) of this family, and especially in the identifications, the writer has received invaluable help from Dr. Sig. Thor, of Oslo, to whom he is deeply indebted.

Suborder PROSTIGMATA Kramer, 1877.

Family BDELLIDAE Koch, 1842.

SYNOPSIS OF GENERA (after Sig. Thor).

1. Segment V. of palp shortened and apically broadened, with 2 or 3 long apical hairs. Mandibles each with two dorsal hairs. Thorax with 2 pairs of hairs and usually 2 narrow longitudinal chitinous shields, these seldom absent. 2

   Segment V. of palp relatively long, cylindrical. Mandibular hairs 1, 2 or many. Thorax with only 2 or 3 pairs of hairs. No chitinous shields on shoulders, seldom a broad chitinous plate. 5

2. An unpaired median frontal eye and two pairs of lateral eyes. Rostrum and mandibles short and thick. The two longitudinal shoulder shields bound anteriorly by a transverse chitinous line.

   Genus *Cyta* Heyden, 1826.

   Only the lateral eyes present. Mandibles and rostrum long and narrow. Dorsal shields separated, indistinct or absent. 3

3. Cuticle thick, patterned. No thoracic shields.

   Genus *Trachymolgus* Berlese, 1923

   Cuticle thin and finely striated. Thorax with longitudinal shields or shorter lines. 4

4. Two longitudinal, relatively distinct thoracic shields. Rostrum and mandibles of normal width. Two long mandibular hairs, one more basal, the other in the middle.

   Genus *Bdella* Latreille, 1795.

   Two short chitinous stripes with a pair of humps. Rostrum and mandibles very narrow, almost needle-like. Both mandibular hairs very small and placed beyond the middle.

   Genus *Spinibdella* Sig. Thor, 1930.

5. Both apical hairs of fifth palpal segment very long. Mandibles with 1 or 2 hairs. 6

   Both apical hairs of fifth palpal segment not or only slightly lengthened. Mandibles with many hairs (5-24). Three pairs of dorsal thoracic hairs.

   Genus *Molgus* (Dujardin, 1842) Trouessart, 1894.

6. Each mandible with only one hair. No thoracic shields.

   Genus *Scirus* Herman, 1804.

7. Each mandible with two hairs. Generally 2 (seldom 3) dorsal thoracic hairs. Distally on thorax a very fine subcutaneous line.

   Genus *Biscirus* Sig. Thor, 1913.

Genus CYTA Heyden, 1826.

Cyta latirostris (Herman), 1804.

Fig. A, figs. 1-2.

This very small red species is widely distributed in Western Australia. It occurs under bark, etc., where it is probably predaceous on Psocids and other small insects. Apart from its size it is easily recognised by its characteristic shape and by its mandibles. It is a well-known species in Europe and has also been recorded from Northern Africa. A second European species is known, *C. coerulipes*

(Dug.), which differs in having more elongate mandibles and blue legs. This species has not yet been found in Australia.

Localities.—Perth, W. Aust., May 4, 1931 and onwards, (H. W.); Gooseberry Hill, W. Aust., June 2, 1932 (G. E. N.); Donnybrook, W. Aust., June 29, 1932 (E. M.); Denmark, W. Aust., July 5, 1932 (H. W.); Glen Osmond, S. Aust., June, 1933 (H. W.).

Genus Bdella Latreille, 1795.

Bdella lignicola Can., 1885.

Fig. A, figs. 3-8.

Length to 900 μ. Colour pinkish. Mandibles long and slender with two long hairs; width 25 μ. at widest part; jaws small. Rostrum 200 μ. with three pairs of hairs on ventral surface, the basal pair much smaller and finer than the others. Palpi reaching slightly beyond the tip of the mandible; ratio of lengths of segments I. : II. : III. : IV. : V. = 15 μ. : 160 μ. : 30 μ. : 22 μ. : 35 μ., total 262 μ., segment II. with 7 hairs, III. with 1, IV. with 4, and V. with 4, apical setae of segment V. long, the longer one almost as long as the palp, the shorter one two-thirds of the longer. Cephalothorax with the usual arrangement of hairs. Eyes two on each side almost touching, less than a diameter apart. Striation of thorax as figured. Abdomen with five rows of hairs, 4, 2, 2, 2, 4. Legs normally haired.

Specimens of this species have been found by the writer at Glen Osmond, South Australia, in March, 1933, and also in moss from the higher reaches of Waterfall Gully, South Australia, May, 1933.

Genus Scirus Herman, 1804.

Sig. Thor (1931) gives only 3 valid and 3 incertain species as belonging to this genus. Only one of the valid species has so far been found to occur in Australia, but a new species, *Scirus dubitatus*, n. sp., is here brought forward from Tasmania.

The four species may be separated by the following key:—

1. Palpi of moderate length, segments III. and IV. subequal, V. at least thrice as long as III. and IV. together. 3

   Palpi very long, IV. much longer than III., V. at most twice as long as III. and IV. together. 2

2. Palpi long (1,200 μ.) and strong. Segment IV. of palp twice as long as III., V. one and a half times as long as III. and IV. together, II. longer than two-thirds the rostrum. Length to 1,800 μ.
   S. porrectus (Kramer).

   Palpi extraordinarily long and thin (2,000 μ.). Segment IV. half as long again as III., V. twice as long as III. and IV. together. Length (without rostrum), 2,600 μ.
   S. exilicornis (Berlese).

3. Mandibles short and stout, width at widest part not less than one-third the length. Thorax with a very distinct subcutaneous shield, widely bridged anteriorly. Length, 1,625 μ.
   S. dubitatus, n sp.

4. Mandibles more slender, at least four times longer than broad. No thoracic shield. Palp V. slightly shorter than II., apical setae about two-thirds the length of apical segment, segment II. with 10-15 hairs. Jaws of mandible with inner distal tooth.
   S. longirostris Herman.

Scirus longirostris Herman, 1804.

Fig. A, figs. 9-11.

This common and widely distributed species has been on several occasions observed feeding upon *Sminthurus viridis* and other Collembola, but does not appear to occur in the density necessary for effective biological control. It may possibly be an introduction from Europe.

Localities.—Rottnest Island, W. Aust., January 31, 1931 (H. W.); Perth, W. Aust., May 4, 1931 (H. W.); Waite Institute, Adelaide, S. Aust., May 12, 1930 (?); Guildford, W. Aust., 1931 (H. W.); Busselton, W. Aust., 1931 (H. W.); Waite Institute, Adelaide, S. Aust., June, 1931 (D. C. S.); Middle Swan, W. Aust., June 5, 1932 (H. W.); Bridgewater, S. Aust., June 6, 1932 (D. C. S.); Crawley, W. Aust., June 30, 1932 (H. W.); Sassafras, Vict., December, 1931 (H. G. A.); Muresk, W. Aust., August 5, 1932 (H. G. A.).

Scirus dubitatus, n. sp.

Fig. A, figs. 12-15.

Diagnosis.—Length 1,625 μ. Rostrum 270 μ. with 5 pairs of ventral hairs. Mandibles 300 μ. long, very broad basally, 95 μ. wide with a single hair 135 μ. from apex and 78 μ. long. Palpi 360 μ. long, segments II. : III. : IV. : V. = 180 μ. : 30 μ. : 25 μ. : 157 μ. with respectively 8 : 1 : 3 : 9 hairs, apical setae of segment V. subequal 157 μ. and 152 μ. long. Thorax with a very distinct subcutaneous shield on each shoulder and broadly bridged anteriorly, with three pairs of long sensory setae (cf. fig. A, fig. 13). Body setae normal, 65 μ. long. Tarsus as in figure.

Locality.—Under stones on Mount Nelson, Tasmania, September 2, 1932 (V. V. H.). One specimen.

Remarks.—This is a particularly interesting species in that it has such a distinct thoracic shield and three pairs of thoracic hairs. These characters would place it in the genus *Molgus,* but the single mandibular hair and the long apical setae of the palpi are diagnostic of *Scirus.* In view of difficulties like this one can be pardoned for questioning the justification of such generic characters.

Genus Biscirus Sig. Thor, 1913.

This genus is divided by Sig. Thor into two subgenera *Odontoscirus* S. T. in which the jaws of the mandibles are toothed, and *Biscirus* s. str. in which they are without dentitions.

As no fewer than nine of the thirteen species of Bdellidae here listed for Australia belong to this genus, the following key is given for all known valid species based on that of Sig. Thor (1931):—

1. Mandibles with teeth to jaws. Subgen. *Odontoscirus* Sig. Thor, 1913

Rostrum 300-420 μ. Mandibles 6-7 times as long as broad, both hairs about 75 μ. apart, distal 180 μ. from tip, proximal 165 μ. from base. Jaws of mandibles of equal length, fixed arm with 2 small teeth, movable arm with 4-5 median teeth (3 in var. *dentata* Sig. Thor, 1931). Rostrum ventrally with 6 pairs of hairs. Palpal segments I. : II. : III. : IV. : V. = 25 μ. : 300 μ. : 45 μ. : 38 μ. : 250 μ., II. with 6 hairs, V. with 6-9 hairs. Apical setae of V. 220 μ. Length of animal without rostrum, 2,000 μ.
B. (O.) virgulatus (Can. et Fanz., 1876).

Mandibles without teeth.
Subgen. *Biscirus* s. str. Sig. Thor, 1913. 2

2. Both mandibular hairs in close proximity. 3

Mandibular hairs widely separated. 4

3. Large species 1,700-2,000 μ. Rostrum 660 μ., ventrally with 5-7 pairs of hairs. Mandibles 600 μ. with 2 adjacent hairs about the middle and 230-260 μ. long. Palpi 1,000 μ., segments I. : II. : II. : III. : IV. : V. = 25 μ. : 460 μ. : 88 μ. : 135 μ. : 330 μ., II. with 4 hairs, III. with 1, IV. with 3, and V. with 7. Apical setae of palpi relatively short, 340 μ. and 290 μ. *B. (B.) norvegicus* Sig. Thor, 1905 (Europe).

Small species 1,100 μ. Rostrum 250 μ., ventrally with 7 pairs of short hairs. Mandibles 220 μ. long, 90 μ. broad at base, as in preceding species but shorter. Hairs of mandibles (65 and 75 μ.) close together in middle. Palpi more like those of *lapidarius* than *norvegicus,* segments I. : II. : III. : IV. : V. = 22 μ. : 110 μ. : 30 μ. : 33 μ. : 105 μ., II. with 3 hairs, V. with 6 hairs with two others near to the apical setae and relatively long as in *norvegicus.* *B. (B.) meridionalis* Sig. Thor, 1931 (N. Africa).

4. The proximal mandibular hair very much reduced, distal hair normal. Rostrum 405 μ. long with 5 pairs of ventral hairs. Mandibles 470 μ., proximal hair 145 μ from base, 24 μ. long in female, 6-8 μ. long in male, distal hair 160 μ. from proximal and the same distance from tip, 90-110 μ. long. Segments of palpi, I. : II. : III. : IV. : V. = 30 μ. : 370 μ. : 65 μ. : 65 μ. female, 85 μ. male : 360 μ. Apical setae of palpi 175 and 150 μ. long.

B. (B.) intermedius Sig. Thor, 1928.

Both mandibular hairs normally developed. 5

5. Segment V. of palp only two-thirds the length of II. 6

Segment V. of palp equal to II. 7

6. Palp V. long and thin. Rostrum with 6-7 pairs of ventral hairs. Length of animal to 1,580 μ. Mandibles 400 μ., proximal hair 178 μ. from distal, this 126 μ. from tip. Palpi 580 μ. long, segments I. : II. : III. : IV. : V. = 30 μ. : 258 μ. : 40 μ. : 32 μ. : 180 μ., II. with 5 hairs, III. with 1, IV. with 2, and V. with 9 hairs. Apical setae of V. 232 and 174 μ. long. Mandibular hairs 90 and 120 μ. long. *B. (B.) australicus*, n. sp.

Palp relatively shorter and thicker. Rostrum ventrally with only 2-3 pairs of hairs. Length of animal to 2,000 μ. long. Mandibles 500 μ. long, proximal hair 155 μ. from base, distal hair 120 μ. from tip, these hairs only 50-75 μ. long. Palp V. with only 4 hairs, II. with only 2 hairs, one proximal and one distal. *B. (B.) silvaticus* (Kramer), 1881.

7. Segment IV. of palps longer than III. 8

Segment IV. approximately equal to III. 11

8. Segment IV. of palps only one and a half as long as III. 9

Segment IV. three times as long as III. 10

9. Palpi and legs with numerous simple and fine short hairs. Length of body 3,000 μ. Mandibles 615 μ., proximal hair 186 μ. from distal, this 186 μ. from apex, these hairs 145 μ. long. Palpi 2,430 μ. long, segments I. : II. : III. : IV. : V. = 214 μ. : 858 μ. : 143 μ. : 214 μ. : 1,000 μ., apical setae of V. 256 μ. only a little longer than the rest.

B. (B.) hickmani, n. sp.

Palpi and legs normally haired. Length of body 1,400 μ. Mandibles 500 μ., hairs as in *B. (B.) lapidarius*. Palpi 900 μ. long, segments II. : III. : IV. : V. = 350 μ. : 70 μ. : 110 μ. : 300 μ., II. with 2 (?) distal hairs, IV. with 4 distal and V. with 11 hairs. Apical setae of V. long.

B. (B.) uncinnatus (Kramer), 1898.

10. Palp V. twice as long as IV. Serrated hairs for some distance along tarsi? Rostrum 420 μ. long. Palp V. entirely over-reaching tip of rostrum, II. : III. : IV. : V. = 270 μ. : 40 μ. : 110 μ. : 220 μ. Length of body 1,250 μ.

B. (B.) anomalicornis (Berlese), 1916.

Palp V. only one-third as long again as IV. Tarsi with only 2-3 serrated setae at tip.

Rostrum 640 μ. long. Palpi with the whole of V. and half of IV. over-reaching tip of rostrum, II. : III. : IV. : V. = 450 μ. : 90 μ. : 260 μ. : 350 μ., II. with 2 hairs, one distal and one basal, III. with 1 hair, IV. with 2 distal hairs and V. with 4. Apical setae of palps equal, 270 μ. long. Mandibles 670 μ. long, proximal hair 239 μ. from distal, distal 180 μ. from tip, these hairs 92 and 120 μ. long, respectively. Rostrum ventrally with two pairs of hairs. Length of body, 3,500 μ. *B. (B.) thori*, n. sp.

11. Palpi relatively short and thick, especially segment V. Rostrum 360 μ. long, ventrally with 6 pairs of short hairs. Mandibles with long hairs, the distal one placed about the middle, 120 μ. long, the proximal one 108 μ. long. Palpi 435 μ. long, segments I. : II. : III. : IV. : V. = 24 μ. : 180 μ. : 43 μ. : 48 μ. : 154 μ., II. with 5 hairs, V. with 8-10 hairs, apical setae 185 μ. and 170 μ. *B. (B.) lapidarius* (Kramer), 1881.

Palpi comparatively longer and thinner. 12

12. Legs slender and sparsely haired. Claws very thick. Palp V. shorter than II. Length, 1,250 μ. *B. (B.) splendidus* (Stoll), 1887.

Legs and claws normal. Palp V. equal to II. Rostrum 500 μ., ventrally with 5 pairs of hairs. Palpi 800 μ. long, II. : III. : IV. : V. = 340 μ. : 60 μ. : 60 μ. : 340 μ., II. with 6-7 hairs, IV. with 3-4, and V. with 9-10, apical setae two-thirds the length of V.

B. (B.) symmetricus (Kramer), 1898.

Biscirus (Odontoscirus) virgulatus (Can. et Fanz.), 1876.

Fig. B, figs. 29-31.

This species is very local and has only been taken in one locality in Western Australia. It is well known in Europe, and the writer has also found it on the Cape Flats, in South Africa, in 1930.

Locality.—Pelican Point, Perth, W. Aust., June 2, 1932 (H. W.).

Biscirus (Biscirus) intermedius Sig. Thor, 1928.

Fig. B, figs. 14-15.

This species, hitherto only known from Norway, is apparently widely distributed in Australia. Sig. Thor (1931 a) gives the length of the proximal mandibular hairs as from 15-25 μ. In the Australian specimens this hair varies in length according to the sex; in the female it is about 24 μ. long corresponding to Sig. Thor's measurements, in the male it is much shorter only varying from 6-8 μ. Segments III. and IV. of the palps also show a difference in the relative lengths. In the female sex these two segments are subequal, in the male IV. is one-third longer than III.

Localities.—Beverley, W. Aust., June 4, 1931 (H. W.); Waroona, W. Aust., August 6, 1931 (H. W.); Busselton, W. Aust., August 26, 1931 (H. W.); Mullewa, W. Aust., September, 1931 (H. W.); Cascades, Tasm., June 11, 1932 (V. V. H.); St. Ronan's Well, W. Aust., June 1, 1932 (G. E. N.); Denmark, W. Aust., July 5, 1932 (H. W.); Muresk, W. Aust., August 4, 1932 (H. G. A.).

Description of Figure B.

Fig. 1.	*Biscirus lapidarius* (Kramer).	Cephalothorax of adult.
2.	„ „ „	Palp of adult.
3.		Mandible of adult.
4.		Tibia and tarsus of adult.
5.	.. ..	A dorsal seta.
6.	*thori*, n. sp.	Rostrum.
7.	„ „ „	Mandible.
8.	„ „ „	Palp.
9.	„ „ „	Tip of tarsus and claws.
10.	„ „ „	Mandibular shears.
11.	*australicus*, n. sp.	Mandible.
12.	„ „ „	Palp.
13.	„ „ „	Rostrum, ventral.
14.	*intermedius* Sig. Thor.	Palp and mandible of male.
15.	.	Base of female mandible.
16.	*silvaticus* (Kram.).	Palp.
17.	„ „	Mandible.
18.	„ „	Rostrum, ventral.
19.	„ „	Tibia and tarsus.
20.	*symmetricus* (Kram.).	Left eyes (from remounted co-types).
21.	„ „	Mandible .. .. „
22.	„ „	Rostrum from side. (Ditto.)
23.	„ „	„ ventral (from other specimens).
24.	„ „	Mandible (from other specimens).
25.	„ „	Cephalothorax (from other specimens).
26.	„ „	Palp.
27.	*uncinnatus* (Kram.).	Palp.
28.	„ „	Mandible.
29.	*(Odontoscirus) virgulatus* (C. & F.).	Palp.
30.	.. „ „ „	Mandible.
31.	„ „ „ „ „	Tibia and tarsus.

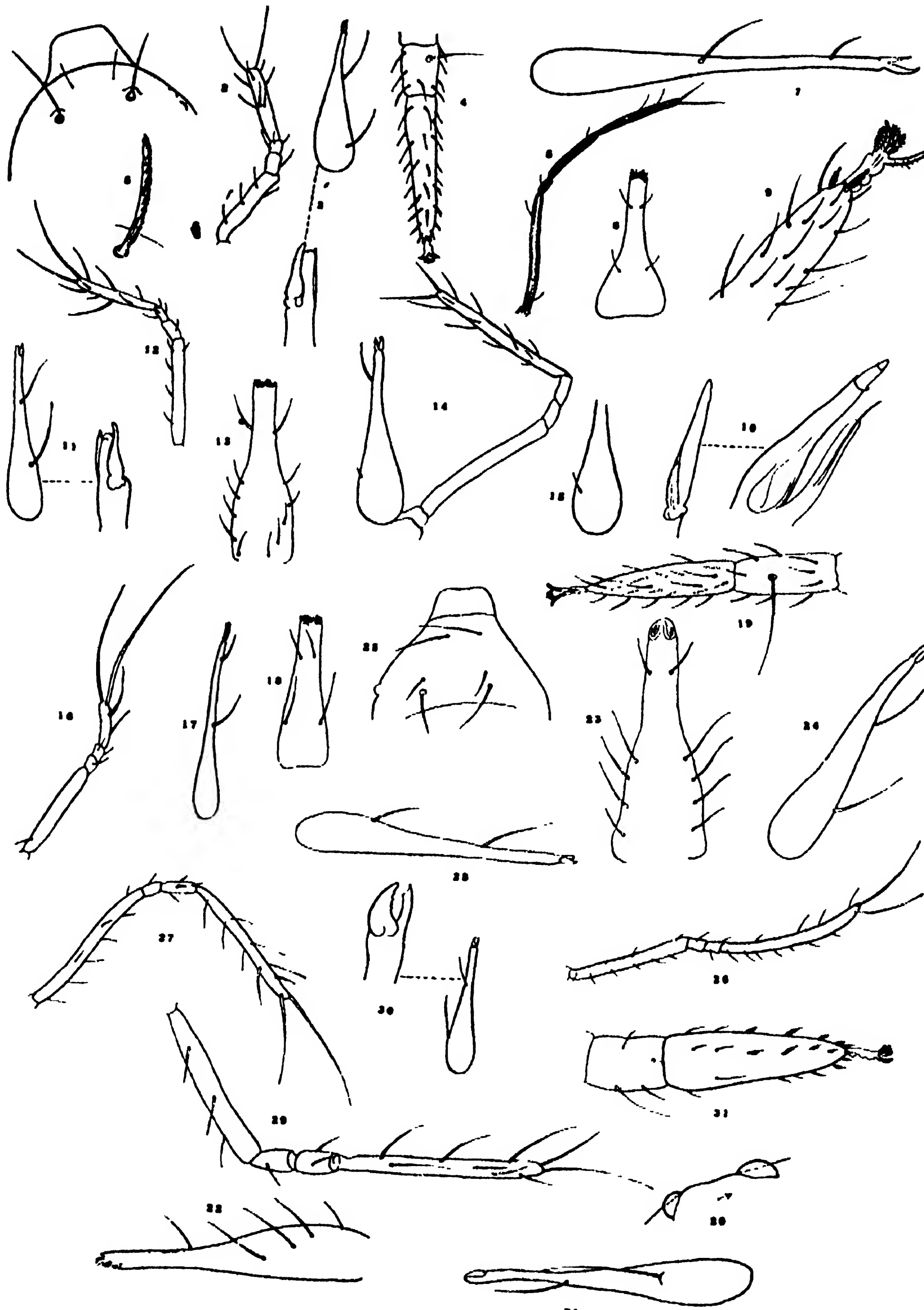


Fig B. For description see opposite page.

BISCIRUS (BISCIRUS) UNCINNATUS (Kramer), 1898.

Fig. B, figs. 27-28.

This is apparently a rare species in Australia. The material examined agrees entirely with the details given by Sig. Thor, except that in his figure of the palp (after Kramer) he shows only two distal hairs on segment II. In the Australian material there are at least 8 hairs more or less evenly distributed. This species has previously been recorded from America.

Localities.—National Park, Tasm., August 22, 1932 (V. V. H.); Denmark, W. Aust., July 5, 1932 (H. W.).

BISCIRUS (BISCIRUS) SILVATICUS (Kramer), 1881.

Fig. B, figs. 16-19.

This well-known European species has only once been found in Western Australia. The determination was confirmed by Dr. Sig. Thor.
Locality.—Perth, W. Aust., May 5, 1931 (H. W.).

Biscirus (Biscirus) thori, n. sp.

Fig. B, figs. 6-10.

This is a large and local species the specific characters of which have been given in the key. It is named after Dr. Sig. Thor as a slight mark of esteem.
Localities.—Beverley, W. Aust., June 4. 1931 (H. W.); Muresk, W. Aust., June 6, 1932 (H. G. A.).

BISCIRUS (BISCIRUS) LAPIDARIUS (Kramer), 1881.

Fig. A, figs. 21-27; Fig. B, figs. 1-5.

This is a well-known species in Europe and has also been recorded from North Africa. In Western Australia it is widely distributed although rather local. A full description of this species and its possible value as an agent of biological control of the Lucerne Flea (*Sminthurus viridis* L.) have been given elsewhere (J. C. S. I. R., May, 1933). It can be distinguished from its allies by the above key.
Localities.—Waroona, W. Aust., 1931 onwards (H. W.); Denmark, W. Aust., 1931 onwards (H. W.); Burekup, W. Aust., 1931 (H. W.); Benger, W. Aust., 1932 (E. M.); Donnybrook, W. Aust., 1932 (E. M.); Cannington, W. Aust., 1932 (H. W.).

BISCIRUS (BISCIRUS) SYMMETRICUS (Kramer), 1898.

Fig. B, figs. 20-26.

A generally widespread species in Australia south of the Tropics but previously only known from South America. The identification of this species has been confirmed by Dr. Sig. Thor.

In 1916 Banks described *Bdella (Scirus) hospita* from specimens taken in ant nests in Victoria and Tasmania by the late Mr. A. M. Lea. In the South Australian Museum are three co-types of Banks' material. As these were mounted in Canada Balsam it was not possible to make out details sufficient to verify the diagnosis. The writer, however, has remounted the specimens and can now state that they are identical with *Biscirus symmetricus* (Kramer). All three specimens, unfortunately, lack palpi, but the drawing given by Banks fits in with Kramer's species. Banks, however, describes them as having only one eye on each side. This is erroneous for there are distinctly two as shown in a figure of the remounted material.

Whether the specimens were really myrmecophilous is extremely doubtful. Their occurrence in the nests of ants was more probably accidental.

Localities.—Lal Lal, Vict., date ?, A. M. Lea, with ? *Polyrachis hexacantha;* Chudleigh, Tasm., date ?, A. M. Lea, with ? *Iridomyrmex*. In W. Aust. at Muresk, Denmark, Busselton, Mullewa and Albany, 1931-2; Trevallyn, Tasm., August 17, 1929 (V. V. H.); Launceston, Tasm., June 27, 1931 (V. V. H.); National Park, Tasm., March 27, 1932 (V. V. H.); Brown Hill Creek, S. Aust., June 25, 1932 (D. C. S.).

Biscirus (Biscirus) hickmani, n. sp.

Fig. A, figs. 16-20.

This is a very large and striking form, of which only two specimens have so far been collected. In the short terminal setae of the palpi it shows some relationship to the genus *Molgus*. The details of specific value are fully given in the key and amplified by the figures. It is named in honour of its discoverer.

Locality.—Under stones, National Park, Tasm., March 27, 1932 (V. V. H.).

Biscirus (Biscirus) australicus, n. sp.

Fig. B, figs. 11-13.

This species is very closely related to *B. (B.) silvaticus* Kramer but is quite distinct in the length of the palpi and the hairs on the ventral surface of the rostrum, as well as the other characters given in the key.

It has only been found, so far, at Waroona, W. Aust., August 6, 1931 (H. W.), and at Waite Institute, Glen Osmond, S. Aust., June, 1933 (D. C. S.).

Bibliography.

Banks, N. .. .. 1915 The Acarina or Mites. U.S. Dept. of Agric. Report No. 108.

" " .. .. 1916 Acarians from Australian and Tasmanian Ants and Ant Nests. *Proc. Roy. Soc. S.A.* VII., 224.

Oudemans, A. C. .. 1926 Acari von Svalbard (früher "Spitzbergen"). *Archiv. f. Naturges.* A. 106-.

Sig. Thor .. .. 1931 Bdellidae. *Das Tierreich.* 56.

" " .. .. " Nordafrikanische Bdellidae und Cunaxidae. *Zool. Anz.* 97, 62-79.

Vitzthum, H. Graf .. 1929 Acari. In "Die Tierwelt Mitteleuropas." 3.

ON SOME ACARINA FROM AUSTRALIA AND SOUTH AFRICA.

By H. Womersley, F.R.E.S., A.L.S., Entomologist, South Australian Museum.

[Read September 14, 1933.]

During September, 1930, the writer spent some weeks in Cape Province, South Africa, to study the occurrence there of the pest known in Western Australia as the Red-legged Earth Mite, and which was the same as Black Sand Mite or "aardvloei" of the Cape. In the district within about 30 miles of Cape Town this mite is a serious pest on the market garden crops, but as the country is not given over to large pastures as in Australia the distribution and abundance is not so large. As the mite had first been described from Cape Province several years before it was noticed in Western Australia and not from elsewhere, it had been concluded that South Africa was its home. The possibility, therefore, that in Cape Province, if anywhere, might be found some natural control, led to the writer's visit under the auspices of the Commonwealth Council for Scientific and Industrial Research.

The correct nomenclature of this species of mite, and also a closely related form, has hitherto been somewhat uncertain to entomologists, and the aim of this paper is mainly to clear this up. In addition, the opportunity is taken to record several other species of Acarina occurring in South Africa and Australia.

Family PENTHALEIDAE Oudemans, 1931.

This family, as defined by Dr. A. C. Oudemans, contains only two genera, *Halotydeus*, in which the anal opening is situated terminally, and *Penthaleus* with a dorsal anus.

Genus Halotydeus Berlese, 1903.

Syn. *Penthaleus* Koch, 1838 (in part).

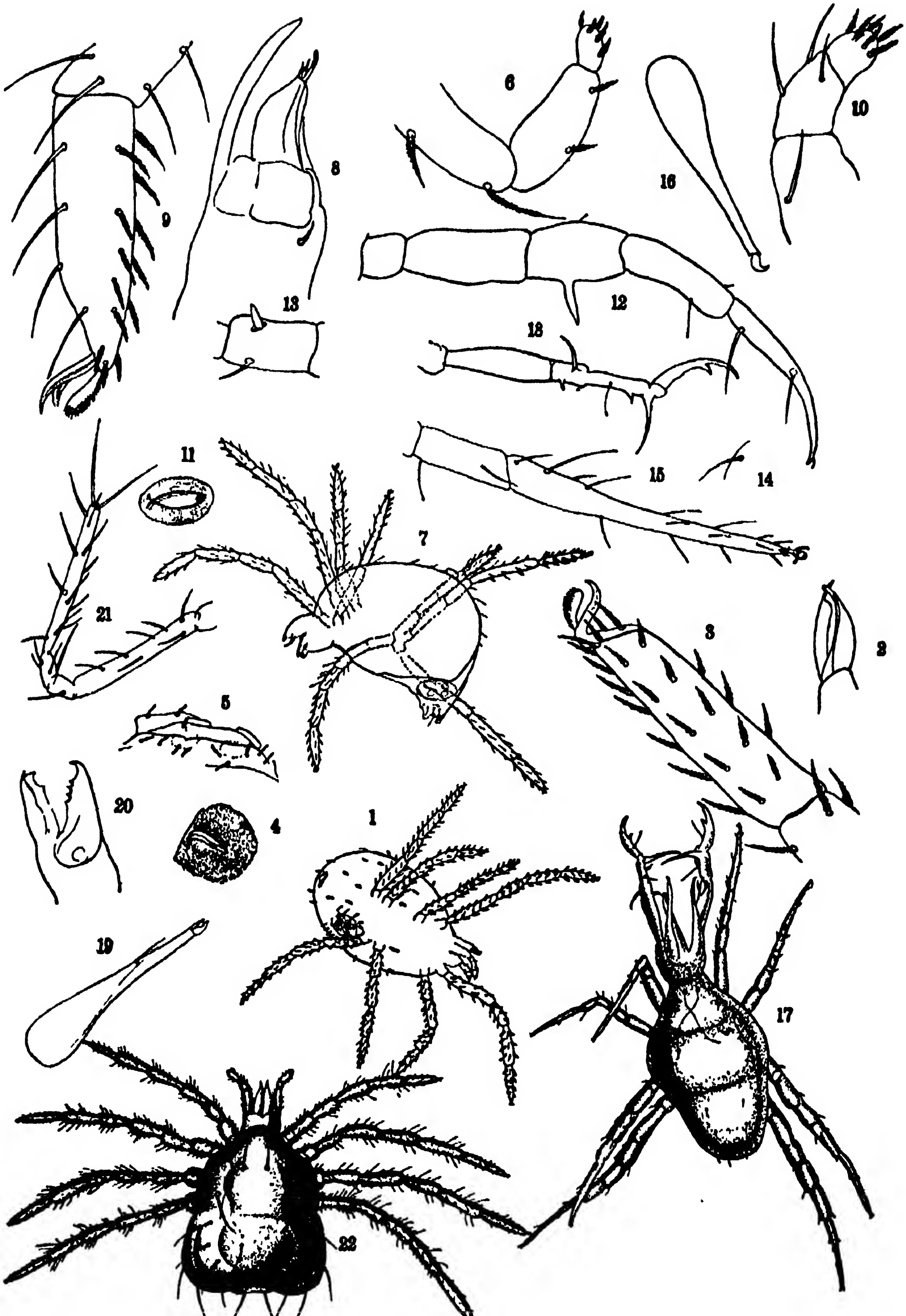
Halotydeus destructor (Jack), 1908.

Figs 1-6.

This mite was first recorded as the Black Sand Mite from Cape Province, South Africa, by Jack in 1908 under the name of *Penthaleus destructor*. Not until 1925, however, was it described in detail, when R. E. Tucker published his memoir. In 1923 it was recorded from Western Australia by L. J. Newman as *Notophallus bicolor* Froggatt, a name given two years earlier to an allied species occurring in New South Wales. Shortly after the publication of Tucker's paper the leaflet of the Western Australian Department of Agriculture was revised, the name being changed to *Penthaleus destructor*.

As recorded by Jack and by Tucker, this mite is very abundant and a serious pest in South Africa on market garden crops such as lettuce. In Western Australia it is widely distributed in almost unbelievable numbers on Subterranean Clover, Cape Weed and many other plants. It also occurs similarly in South Australia, and the writer has had specimens for identification from Victoria, New South Wales, Tasmania and Federal Territory.

In South Africa, in seeking a possible natural control, the writer paid particular attention to two localities. At the Marsh Memorial Homes, Rondebosch, suspicions were directed to a predatious mite belonging to the Bdellidae (*Odontoscirus virgulatus* Can.) which was present in considerable numbers along with the Sand Mite. In the field, observations failed to show any cases of the Bdellid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attacking the Sand Mite, although various small Collembola and Psocids were often attacked. In captivity no evidence could be obtained.

It is the writer's considered opinion that as both this and the next species to be discussed occur together in both countries, and that as one of them may possibly be synonymous with a European species, they are probably introductions to both continents. The European species, which may be the same as the next one to be discussed, has been recorded occasionally to reach pest numbers in France, and it would seem that France and the Southern Mediterranean Region may be their native home and furnish some controlling agency.

The figures given in the plate illustrate the microscopic characters by which this species can be distinguished from its ally. In the field it is not so globose and does not have the dorsal red spot characteristic of the next form. It is entirely black with red legs, which just after an ecdysis are whitish. Occasionally a form is found in which the dorsum is uniformly brown and sharply marked off from the black venter. No morphological differences could be found between this form and the normal.

Genus PENTHALEUS Koch, 1838.

Syn. *Notophallus* R. M. Can., 1886.

PENTHALEUS BICOLOR Froggatt, 1921.

Syn. ? *Penthaleus major* (A. Duges, 1834).
? *Penthaleus haematopus* Koch, 1835.
? *Penthaleus insulanus* Thorell, 1872.

Figs. 7-11.

This species was first described in a very insufficient manner by Froggatt in 1921 as the Blue Oat Mite *(Notophallus bicolor)* from New South Wales. The writer first met with it in South Africa, where it was previously unknown, in all localities where the previous species was to be found. In Western Australia it is similarly to be found, although not in such immense numbers. In certain parts of South Australia it can be considered a minor pest, and in New South Wales has been regarded as serious. It has also been received from Victoria and Federal Territory.

Although no recent detailed descriptions of the European *Penthaleus major* or *haematopus* have been published, it does appear to the writer that there is a possibility that our Australian form may be the same.

Description.—Size to 1·0 mm. rather larger than the preceding species. Colour black with a red dorsal patch surrounding the anus. Legs red, brighter than in preceding. Venter and sometimes the back of the cephalothorax reddish. The palpi are short, three segmented, and the segments relatively shorter and broader than in *H. destructor*. The mandibles are short with the movable finger of practically uniform width, whereas in the previous species it is truncate just before the apex and ends in a fine point. Only the apical segment of the palpi has serrated or feathered setae. The body is more globular than in *Halotydeus* and has the anus situated dorsally. The genital organ on the venter has the usual two pairs of suckers. The first and fourth pairs of legs are the longer and the tarsi end in a pair of strong claws and median pulvillus. The setae on the body and the legs are all strong and simple, except on the under-surface of the tarsi where they are serrated. In *H. destructor* all the setae on the tarsi are serrated.

Neither in this nor the preceding species have males yet been discovered, and both would appear to be largely parthenogenetic as suggested by Tucker for *H. destructor.*

Family BDELLIDAE Duges, 1834.

Genus Biscirus Sig. Thor, 1913.

Subgenus Odontoscirus Sig. Thor, 1913.

Odontoscirus virgulatus Can. et Fanz.

This species was abundant along with *Halotydeus destructor* (Jack) in many market garden areas around Rondebosch and Stellenbosch, Cape Province, South Africa, in 1930. It is almost world-wide in its distribution, and has recently been recorded from Northern Africa and Australia.

Genus Scirus Herman, 1804.

Scirus hessei, n. sp.

Figs 19-21.

Description.—Length, 2·1 mm. Rostrum with 5 pairs of ventral hairs. Mandibles long, reaching tip of rostrum, 430 μ., with a single hair 125 μ. from the tip and 65 μ. in length. Palpi 725 μ., segments II. : III. : IV. : V. = 300 μ. : 50 μ. : 50 μ. : 310 μ.; apical setae of V. 110 μ. and 100 μ.; segment II. with 7-8 hairs, III. with 1, IV. with 4, and V. with 12 hairs. Jaws of mandibles dentate, fixed finger with 2 teeth, movable finger with a strong apical tooth and four smaller median teeth. Eyes, two on each side. Legs and body normally haired.

This species, which the writer has much pleasure in naming after his friend, Dr. Hesse, of the Cape Town Museum, was present in small numbers in a tube of Collembola collected by Dr. Hesse at Stellenbosch C.P., South Africa, August 28, 1927.

The species is very close to *Odontoscirus virgulatus,* but belongs definitely to *Scirus* in having only a single mandibular hair. In its dentate mandibles it occupies a similar position to typical species of *Scirus* that *O. virgulatus* does to typical *Biscirus.*

Family CUNAXIDAE Sig. Thor, 1902.

Genus Cunaxa v. Heyden, 1826.

Cunaxa setirostris (Herman, 1804).

Figs. 12-16.

This is a very small scarlet mite found commonly under loose bark on fallen twigs in many parts of Western Australia, from Perth southwards. It occurs along with *Cyta latirostris* but is very much smaller and more brilliant in colour. It is easily distinguished by its shape and the extraordinary palpi. It is a well-known species in Europe, and Dr. Sig. Thor has kindly confirmed my identification of specimens from Perth. It also occurs in South Australia, in the Adelaide district.

Cunaza taurus.

Figs. 17-18.

This species occurred with the preceding in the Perth area during 1931-2. It is also a European species, and can be distinguished by the palpal structure.

Family ANYSTIDAE Oudemans, 1902.

Genus Anystis v. Heyden, 1826.

Anystis baccarum (Linnè, 1758).

Fig. 22.

This is a reddish mite of a characteristic square or trapezoidal shape which often occurs in considerable numbers on low herbage. It is predatious in habit and has been observed feeding upon Collembola, Thrips and other soft-bodied

insects. Its movements consist of a series of circles. It occurs commonly in the country around Cape Town, South Africa, and the writer has identified it from most areas in Western Australia, south of Geraldton, and from Victoria, South Australia, and New South Wales. It is probably an introduction from Europe.

Bibliography.

Banks, N. .. .. 1915—The Acarina or Mites. Report 108, U.S. Dept. Agric.

Froggatt, W. W. .. 1921—The Blue Oat Mite *(Notophallus bicolor)*. New South Wales Agric. Gazette, No. 32.

Jack, R. W. .. .. 1908—The Earth Flea. Cape of Good Hope Agric. Jour., No. 31.

Marchal, P. .. .. 1908—"*Notophallus haematopus*" (Koch), damaging peas in Central France. *Bull. Soc. Entom.* Fr., No. 3, pp. 41-2.

Newman, L. J. .. 1923—Red-legged Velvet Earth Mite *(Notophallus bicolor)* Froggatt. West Australian Dept. of Agric. Bull. 106.

" " " .. 1925?—The Red-legged Earth Mite *(Penthaleus destructor)* (Jack). West Australian Dept. of Agric. Bull. 106 (revised).

Tucker, R. W. E. .. 1925—The Black Sand Mite: *Penthaleus destructor*, n. sp. Entom. Memoirs, No. 3, Dept. of Agric., South Africa.

Sig. Thor 1931—Bdellidae. Das Tierreich, Lf. 56.

" " .. .. " Nordafrikanische Bdellidae und Cunaxidae. *Zool. Anz.*, v. 97, pp. 62-79.

Vitzthum, H. Graf .. 1929—Acari. Tierwelt Mitteleuropas. Bd. 3.

EXPLANATION OF FIGURE.

Fig. 1. *Halotydeus destructor* (Jack). Entire mite, from below.
" 2. " " " Mandible.
3. Tarsus.
4. Anus.
5. Genital opening.
" 6. Palp.
" 7. *Penthaleus bicolor* (Froggatt). Entire mite.
" 8. " " " Mandible
" 9. " " " Tarsus.
" 10. " " " Palp.
" 11. " " " Anus.
" 12. *Cunaxa setirostris* (Herman). Palp.
" 13. " " " Segment of palp.
" 14. " " " Dorsal seta.
" 15. " " " Tibia and tarsus.
" 16. " " " Mandible.
" 17. " *taurus*. Entire mite.
" 18. " " Palp.
" 19. *Scirus hessei*, n. sp. Mandible.
" 20. " " " " Jaws of mandible.
" 21. " " " " Palp.
" 22. *Anystis baccarum* (Linnè). Entire mite.

THE ECOLOGY OF THE ABORIGINES OF CENTRAL AUSTRALIA; BOTANICAL NOTES.

By Professors J. B. Cleland and T. Harvey Johnston,
University of Adelaide.

[Read September 14, 1933.]

Plate V.

In August, 1932, an expedition organised by the Board for Anthropological Research of the University of Adelaide, in conjunction with the South Australian Museum, and financed in great part by a grant from the Rockefeller Foundation administered by the Australian National Research Council, paid a visit to Mount Liebig, almost due west from Alice Springs and distant 200 miles by road, though only about 142 miles as the crow flies. Mount Liebig is on the route to Ilbilla, some 47 miles further on, which latter place is about 78 miles from the Western Australian border. The country passed through on the way to Mount Liebig, and the immediate surroundings of Mount Liebig itself, give a good idea of the type of country in general and of the facilities for the natives to obtain their various kinds of foods.

Mount Liebig is reached by travelling from Alice Springs 12 miles north over the ranges and then westerly over extensive plains, following closely the northern fringe of the MacDonnell Ranges and skirting outliers of these. The MacDonnells form a series running more or less parallel with each other over a strip of country some 20 or 30 miles wide. Some members of the series are for many miles impassable barriers; others are more or less broken up into separate groups. As one passes westward these separate mountain masses become more prominent and spectacular; several show a striking bluff-like appearance at one end, a mountain range stretching east or west behind this. These mountains and hills extend as far as Mount Liebig, which is their western limit. From the latter one can look in various directions over extensive plains, and observe at varying distances further bold and isolated mountain masses. Ilbilla can be seen to the west; Central Mount Wedge forms a prominent mass to the north-east, some 40 miles away. Between Mount Liebig and Mount Wedge are a series of red sandhills of low elevation with flats between them. The appearance of these parallel ridges running east and west, as viewed from the mountain summit, and as remarked on by Gosse, resembles that of a ploughed field. The various mountain masses are often exceedingly steep, very rocky, and most of them are covered by porcupine grass *(Triodia,* sp.). Amongst these rocks wallabies are to be found, a source of native food, and under their shelter, in some situations, a *Nicotiana,* probably *N. Gossei* Domin, grows luxuriantly, and is much sought after for chewing purposes as a narcotic.

The plains are covered by mulga to varying extents. Another common shrub is known as witchetty bush *(Acacia Kempeana).* Various under-shrubs and herbs grow between and under the mulga, especially where there are more open glades. The sandhill country has a vegetation of its own; a striking feature, in places, is the desert oak *(Casuarina Decaisneana);* while yams *(Ipomoea)* grow here, as well as a porcupine grass used by the natives for obtaining gum.

In such surroundings the native has to find his food supplies. As regards the larger animal foods, these at one time necessarily consisted of the native mammals,

birds, and lizards. The rabbit has now extended probably throughout Central Australia and can supply the natives with an abundance of food without great exertion on their part. They are readily dug out by the women by means of a yam stick. This animal has probably solved one of the difficulties in connection with the food supply of the natives on various reserves. As we passed along the western fringes of the MacDonnell Ranges on our return to Alice Springs we were able to observe towards evening how abundant the rabbits had become, the various warrens passed being well populated by them. The native, when he has to obtain his own food, is probably one of the greatest controlling influences on the multiplication of the rabbit in Central Australia. The only other factors to be considered, besides drought and disease, seem to be eagles and hawks, dingoes and wild dogs, feral cats, and *Varanus* lizards. There have been good seasons recently in Central Australia and the rabbit has multiplied correspondingly. Bad years must be expected, and then rabbits may be serious competitors for the available grass and herbage. They will, under these circumstances, compete with the marsupials, and both may suffer. In the settled parts the rabbits must also be competitors with man's cattle and horses. Unfortunately, in the case of the rabbit, experience elsewhere shows that the harm does not stop here; when food is getting scarce the rabbits turn to other sources than their ordinary food supplies; young bushes and shrubs are eaten; finally the bark may be gnawed from the stems of shrubs and trees to reduce the pangs of hunger, and then these perish as well as the rabbits. As yet, in Central Australia, such destruction by these animals does not seem to have occurred during the recent drought, though apparently rabbits were very greatly reduced in many parts.

The fox is slowly spreading over Australia, following the dispersion of the rabbit. It does not seem yet to have reached north of the MacDonnell Ranges. Feral domestic cats have now wandered far from the immediate neighbourhood of stations; a litter of kittens was found and eaten by the natives during our visit to Cockatoo Creek in 1931. The cats often live in rabbit warrens and probably exercise a considerable control, but doubtless they also destroy many native animals and birds.

At Haast's Bluff, about 50 miles east of Mount Liebig, wild horses were being mustered These animals do not seem to do much harm to the native pastures and herbage. The skeleton of one that had wandered to the foot of Mount Liebig was found during our stay. At Mount Liebig no cattle, camels, goats, horses or donkeys were observed, except such as were in use for transport or food purposes. As yet in the Mount Liebig district, then, with the exception of the rabbit and perhaps some feral cats and dogs, there are no mammals other than those native to the place. The only introduced animal that may be able to alter the appearance of the country or which has modified to any extent the native food supply is thus the rabbit, but the native himself is probably an important controller of it.

The native also exercises a good effect upon the vegetation in his search for witchetty grubs. Some of these are to be obtained in the branches of the gum trees, while others tunnel in the roots of shrubs, such as *Acacia Kempeana*. In both situations they do much damage, and the natives certainly reduce their numbers and minimise their depredations.

A detailed consideration may now be made of the flora from the anthropological aspect. We are indebted more particularly to Mr. J. M. Black and to the Director and staff of the Botanic Gardens, Sydney, for a number of identifications of plants in the following list, and to the Director of the Royal Botanic Gardens, Kew, and Mr. C. E. Hubbard for the identifications of the grasses.

THE USES MADE OF BOTANICAL SUBSTANCES BY THE NATIVES.

FOOD SUBSTANCES.

Grass Seeds.

When at Mount Liebig in August, 1932, most of the grasses were dead, as the annuals come up after the summer rains. Doubtless, in suitable seasons, a number of grasses with grain suitable for winnowing occur in its neighbourhood, though the country cannot be considered as a good grass-bearing one. The only two species pointed out as yielding grain for grinding and making into a kind of damper were *Panicum decompositum* and *Dactyloctenium radulans.*

Other Seeds.

The minute but abundant seeds of *Amarantus Mitchelli* and *A. interruptus* are collected at Macdonald Downs, and probably here also, ground and eaten. The seeds of *Portulaca oleracea,* known in some places as manjeru (munyeroo), are also ground and made into a cake. The seeds of four species of Acacia, namely *A. notabilis,* dead finish, the witchetty bush and mulga, are crushed and eaten. The seeds of *Sida corrugata,* var. *goniocarpa,* are ground and cooked, and those of a Heliotrope are also used.

Tubers and Roots.

These comprise the nut grass or jelka (yelka—a sedge, *Cyperus rotundus),* of which the little rounded tubers are eaten; large yams *(Ipomoea calobra)* which probably yield a considerable amount of starchy food; and the somewhat succulent roots of *Boerhavia, Erythrina, Tribulus* and *Clerodendron.* During our stay at Mount Liebig we heard that there were some parties of natives in the sandhills many miles away busily engaged in digging up yams.

Fruits.

The small native fig is eaten raw, or when dried is ground between stones and made into a paste. The black fruit of *Santalum lanceolatum* is also eaten; the wood of this species, as found in Central Australia, lacks any sandalwood scent. The little fleshy fruits of *Enchylaena tomentosa,* the ruby salt-bush, are also used as food. The pulp and seed of the native orange, *Capparis Mitchelli,* are eaten. Several *Solanum* berries are used as food for man, and others not used by him are eaten by kangaroos and wallabies. *Solanum ellipticum* was quite abundant under the mulga, and its fruit was just becoming ripe during our stay; the berries are greenish white and somewhat marbled and have rather a bitter taste; we certainly wondered how the natives could relish them as they apparently did. The small currant-like fruits of *Carissa Brownii* are eaten.

Plants Eaten Green.

These included the parakilja (parakeelya), *Calandrinia balonnensis,* and the two Asclepiads *Cynanchum* and *Marsdenia.* The leaves of *Convolvulus erubescens* are cooked, or rather steamed.

Zygophyllum as a Source of Moisture for Steaming Purposes.—Under this species will be found a description of an ingenious method of steaming vegetable products, such as the cress *Lepidium papillosum* and *Convolvulus erubescens,* by means of hot stones and the juicy leaves of *Zygophyllum ammophilum.*

Gums.

The gums of *Acacia ligulata, A. notabilis* and *A. Kempeana,* as well as those of *Atalaya* and *Ventilago,* are used as food.

Nectar.

The racemes of flowers of the corkwoods *(Hakea)* and of *Grevillea juncifolia* contain much honey, which is extracted by drawing them sideways through the mouth. Nectar is also obtained by sucking the red flowers of *Eremophila Latrobei.* Sweet material is said to be sucked from the base of the old pods of *Crotalaria dissitiflora.*

Grubs.

Witchety grubs, the larvae of beetles or of moths, are a valuable source of food to the native. These creamy-white creatures vary in size up to the thickness and length of a large finger. Uncertainty will probably be experienced in identifying the species of insect to which they belong owing to difficulties in breeding them out. Witchetty grubs were sought for by the natives in the roots of *Salsola kali,* of the native poplar *(Codonocarpus),* of the witchetty bush *(Acacia Kempeana)* and of *Atalaya.* The large galls on the bloodwood, due to a brachyscelid coccid, are broken open and the juicy insect eaten.

Narcotics.

Pitjuri (Pituri).—This is a term now employed by white people for the narcotic used by the aborigines in Central Australia, and obtained from species of *Nicotiana.* The Aranda name is ingulba. Two kinds are recognised at Mount Liebig. The rock ingulba, which is obtained from *N. Gossei* (probably), and is considered the better, grows as tall as four feet in protected positions on the sides of mountains. A smaller *Nicotiana,* probably a new species, growing on the sandhill country, is also used but is considered inferior. The sticky *Nicotiana suaveolens,* which is often common, coming up under the shelter of fallen mulga branches, is not used. The leaves, stems and roots of ingulba are all used, being dried and ground up on a stone. They are preferably mixed with the ashes of the leaves and twigs of certain trees or shrubs, especially mulga *(Acacia aneura)* and *Acacia ligulata,* after a preliminary moistening in the mouth, and then made into a ball or roll. We also saw many natives using the greenish leaves themselves without their having undergone a preliminary drying. These seemed still damp; mulga ashes were mixed with them and the mass prepared for chewing. This quid is usually carried behind the ear (when not being chewed). In other cases it may be stuck under a head-band or hair string. Chewing ingulba is said to assist the natives during long, dry marches, probably partly by causing salivation. When two natives meet after having been separated, the first greeting, if one of them is without any ingulba, is for the other to give him his quid to chew; it is afterwards put back behind the owner's ear. It may also be used as an overture in love-making, the lover giving the woman some of his ingulba to chew.

Duboisia Hopwoodii (Aranda name, monunga) grows on the sandhill country. It is not used as a narcotic by the natives, but is employed as an emu poison. The leaves and branches are dried in the sun and then pounded with a stone. The poison is then added to rock-holes containing about three or four gallons of water where the emus drink. Some emus are said actually to die beside the water, and others may wander away for a distance of two hundred yards. Most accounts indicate that the birds are merely stupefied.

Aromas used for various purposes.

The burnt leaves and twigs of the native pine are used by some mothers, as the fragrant smell is thought to be pleasant and good for babies. The somewhat aromatic scent of a small blue-flowered *Eremophila Freelingii* is used as a pillow for natives suffering from headache. The sticky aromatic plants *Stemodia viscosa* and *Pterocaulon* are used as remedies for colds.

Woods used for weapons, implements, etc.

The best wood for making spears is considered to be that of *Tecoma*. Smaller and rather heavier spears are made from the branches of *Acacia Kempeana*. Those made from ordinary mulga are considered rather too heavy. Small spears are made from the stem of the supple jack *(Ventilago)*. The "spinifex" gum, that is used for such purposes as fixing a stone into the end of an adze or a spear-thrower, is obtained from a species of porcupine grass *(Triodia*, sp.) that grows on rocky ground. Pitjis (pitchis), receptacles for carrying food or water, are made from the light wood of the bean tree *(Erythrina)*, while smaller ones, used largely as implements for scooping and digging, are manufactured from red-gum.

Plants used for decorative purposes.

The red seeds of the bean tree *(Erythrina)* are used in necklaces. The capsules of the bloodwood *(Eucalyptus dimorphophloia)* were seen threaded into and hanging from the ends of the locks of hair of one woman. The pretty yellow flowers of *Cassia Sturtii* and *C. artemesoides*, the blue flower of *Eremophila Freelingii*, and the pink flowers of *Helichrysum Cassinianum* are used for sticking under the hair-band or sometimes through the pierced septum of the nose—as the natives say in pidgin English, "to make 'em flash." The milky juice of *Euphorbia eremophila* is used for dotting out designs on the body. The purple spores of the stalked puff-ball *Podaxon* are used for smearing over the face. The milky juice of *Sarcostemma* is applied to the nipple to imitate milk when the breasts are well developed, after puberty but before pregnancy has occurred.

Various purposes

Kangaroo Grass *(Themeda australis)* is used to form break-winds, as also is mulga. The grass, *Pappophorum Lindleyanum*, is placed in water that is being carried in a coolamon to prevent the water spilling, or it may be used as a strainer when the water is thick with scum or leaves and débris. The aromatic *Stemodia* is also used for this latter purpose.

PLANTS USED BY THE NATIVES, ARRANGED BOTANICALLY ACCORDING TO THEIR FAMILIES, WITH NATIVE NAMES AND USES.

(Abbreviations: A. = Aranda; L. = Luritja; P = Pintubi; N= Ngalia; Y = Yumu.)

[Note.—It is possible that some of the native names here given may mean not the particular name of a species but a more general term (*e.g.*, an equivalent of our "weed") or even an attribute (*e.g.*, "no good").]

Pinaceae:—

Callitris robusta R. Br., var. *microcarpa*. (Native Pine).—Alknarda (A.). Leaves and twigs used green or dried and burnt to make a pleasant odour for babies.

Gramineae:—

Themeda australis Stapf. (Kangaroo Grass).—Arara (A.). Seed not used. Flower stalks used as a breakwind.

Tragus racemosus All.—Seed not used.

Panicum decompositum R. Br.—Eltjurta (A.). Seeds collected, rubbed by hand (not with the feet), winnowed, ground and made into a damper.

Digitaria Brownei Hughes.—Inama (A.). Seed not used.

Brachiaria distachya (L.) A. Camus.—Ituta (A.). Julumburu (P.).

Aristida arenaria Gaud.—Inturkara (A.). Tjipiri (P.).

Eriachne, sp.—Seed not used.

Pappophorum avenaceum Lindl.—Eratja'ratja (A.).

P. Lindleyanum Domin.—Unama kwatjanambelumba (A.). The plants are used to prevent the spilling of water out of a coolamon or pitchi when it is being carried, or as a strainer for débris, such as a scum or leaves, before drinking.

Triodia, sp. (Aff. *T. Mitchelli* Benth. and *T. Basedowii* E. Pritzel). The common "hill-spinifex" or porcupine grass.—Tjuta or tjurta (A.). Undija (L.). Indolkantji (N.). The seed, ubalabala (A.) or opalapala (A.), is eaten by euros and kangaroos. This species does not yield an adhesive gum.

Triodia, sp.—Tjalanga (A.). Leaves only of a *Triodia,* gathered from rocky ground at Allala (the name of a district), were brought in. The species could not be identified. On some of the leaves were small granular masses of a "gummy" nature resembling fragments of brown sand glued together or part of a termitarium. We were informed that these masses were the materials which supplied the "gum" used for fixing "flints" to the ends of womerahs and adzes. As coccids were present in the adjacent in-rolled margins of the knitting-needle-like leaves, it seems possible that the natural resinous secretion round the leaf sheaths may be increased in amount by the activities of the coccids and so collect in these granular masses loosely enveloping some of the leaf-blades. The plants are collected and hit with a stick over hot sand. The gum is then separated, and while warm mixed with the dung of euro, wallaby or kangaroo, or with some grass, to act as a binding material, and made into flat cakes.

Triodia, sp. Used as a source of "gum." Perhaps the same species as the preceding. Tjalanga (A.). Kiti (L.).

Eragrostis laniflora Benth. Dehusked with the feet in a hole. Entjura (A.). Nantjuri (L.). Wonguna (P.).

Dactyloctenium radulans P. Beauv.—Wanja wanja (A.). The heads are placed in a pitchi, rubbed between the hands, and the seeds winnowed and then ground up and made into a damper.

CYPERACEAE:—

Cyperus rotundus L. (Nut grass or yelka). The underground "tubers," found on the flooded land near the banks of water-courses, are dug up and eaten, after removal of the husk-like covering.

Mariscus Cunninghamii C. B. Clarke (formerly placed under *Cyperus Gunnii* Hook). Viscid.—Angurankura (A.). Ilarapilara (L.).

MORACEAE:—

Ficus platypoda Cunn.—Tjurka. The fruit tjurka an-nga. The fresh fruit is eaten raw. When the fig has dried, it is ground between stones, made into a paste by adding water, and then eaten without being cooked.

PROTEACEAE:—

Hakea lorea R. Br. (Corkwood)—Indjuja (A.). Pūrūa (N.). The honey (judja or tulada, N.) is sucked from the racemes of yellowish-white flowers by drawing these sideways through the mouth.

Grevillea juncifolia Hook.—Erolunga (A.). The large handsome orange-coloured raceme of flowers, ngwala erolunga (A.), are similarly sucked for the nectar.

G. Wickhami Meiss.—Araljukaljukua.

SANTALACEAE:—

Anthobolus exocarpoides ? F. v. M.—Ankarankara (A.). Urtawurta (L.).

Santalum lanceolatum R. Br.—Ilkulai-a (A.) or Arankia (A.). Arang-nurli (L.). The fruit is soaked in water and then eaten and the water drunk.

LORANTHACEAE:—

Loranthus Miquelii Lehm. (on Bloodwood, *Eucalyptus dimorphophloia)*—Immalla (A.).

L. gibberulus Tate (on *Grevillea)*—Immara (A.). Niëmkini (L.).

CHENOPODIACEAE:—

Chenopodium rhadinostachyum F. v. M. Not uncommon. The seeds are probably gathered here as elsewhere, winnowed and made into damper.

Bassia convexula R. H. Anders. Puka puka. The ancestral kangaroo man dragged his penis through this prickly plant and then went into the ground.

Salsola Kali (L.) (Rolly Poly, Buckbush).—Ilkala (A.) or lkala. Tjilkalla (L.) A grub, tjapa (A.); maku (L.), occurs in the stem and root of dead full-grown plants and is eaten.

Enchylaena tomentosa R. Br. (Ruby Saltbush). — Iwurta-wurta or i-wutti-wutta (A. and L.). The deep yellow fleshy "berry" is eaten fresh when ripe. The fruits here were yellow, but elsewhere ruby red fruits also occur.

AMARANTACEAE:—

Trichinium obovatum Gaudich.—Wurra-wurra or woraka lilja (A.). Kondoltja (L.). Mungu-mungurba (N.). Inbai-inbai (N.). The flower-head is used as an ornament.

T. obovatum, var. *grandiflorum* Benth.—Agardagarda (A.).. Talku-talku (L.).

T. exaltatum (Nees) Bent. and *T.* sp., hairy near *T. exaltatum.*—Warakalilja (A.). Albuda-buda (L.).

T. helipteroides F. v. M.—Kaputa-kaputa (A.). (This word itself means "head.") The flower-head is used as an ornament.

Amarantus Mitchelli Benth. and *A. interruptus* R. Br. are both found at Mount Liebig. The seed is collected elsewhere, and probably here also, and eaten.

Alternanthera nana R. Br.—Seeds eaten by rock pigeons [*Lophophaps plumifera* (Gould)].

NYCTAGINACEAE:—

Boerhavia diffusa L.—Wai-ipi (A.). Wai-ipa (L.). Root eaten.

PHYTOLACCACEAE:—

Codonocarpus cotinifolius (Des.) F. v. M. (Native Poplar).—Kalurta (A.). A witchety grub from the root is eaten. The fruit is eaten by white cockatoos.

PORTULACACEAE:—

Portulaca oleracea L. (Purslane, manjeru, munyeroo).—Ljana (A.). Wagati (L. and P.). Wakati-ina-i (N.). The seed is shaken out into a pitji, ground on a stone, soaked with water and eaten. The roots are cooked and eaten and the leaves and stems are boiled and eaten in good seasons, but not when rather dry.

Calandrinia balonnensis Lindl. (Paraki-lja.) Leaves eaten raw or cooked on the embers.

CAPPARIDACEAE:—

Capparis Mitchellii Lindl. (Native Orange.)—Mbultj-ada (A.). Pulp and seed eaten.

Cruciferae :—

Lepidium papillosum F. v. M.—Inmurta or immota (A.). Eaten as a cress.
Stenopetalum nutans F. v. M.—Lei-glia or lei-klia (A.).

Leguminosae :—

Acacia ligulata A. Cunn.—Idurka (A.) or atarkuka or ataruka. Wadarka (L.) or wadruka (L.) or wádarúka (L.). The dried leaf and twig are burnt to obtain ash to mix with pituri. A witchety grub, found in the root when dry, is eaten. The gum is used as food. The seeds are not eaten.

A. notabilis F. v. M.—Tá-wa (A.). The gum is eaten. The seeds are ground between stones and eaten raw.

A. tetragonophylla F. v. M. (Dead Finish).—Wakalbi. The seed is eaten.

A. strongylophylla F. v. M. (prickly).—Parapara (A.). Abérabara (L.).

A. Kempeana F. v. M. (Witchety Bush.) — Tnimma (A.). Eripilli or marko (L.). The branches spread out fan-wise from the base and are moderately straight; they are used for making the smaller and rather heavy spears; south of Hermannsburg these were used for spearing fish. The seeds are picked up from the ground, crushed between mill-stones, freed from dirt by rocking in a pitji, mixed with water, made into a damper and cooked in the fire. The gum that exudes is eaten. Witchety grubs occur in the roots and are much sought after by rabbit-bandicoots, *Thalacomys lagotis*. These scratch the soil away from the roots, but they may be disturbed or may find the root containing the insects too difficult for their extraction. The natives, in searching for these grubs, look for places where marsupials have been burrowing. If they find the root has been gnawed through they proceed no further; but if the root is still intact, then they wrench it out and frequently find the insect. Apparently the rabbit-bandicoots know by the sense of smell which roots contain grubs. Witchety grubs of any kind are known as npi-anba (L.) and turata (P.).

A. aneura F. v. M. (Mulga). There are two varieties of mulga, one with slightly broader and shorter phyllodes (5 cm. x 2·5 mm. as against 7 cm. x 1 mm.), which are not distinguished by the natives.—Ititja (A.) Windalko (L.). Wannari (P.). The seeds (ititja mina, A.; windalko mi-i L.) of both kinds are eaten. Spears made from the wood are considered rather too heavy. The ash of the phyllodes and branchlets, sometimes burnt on a stone, is used to mix with the quid of ingulba *(Nicotiana)*.

Cassia pleurocarpa F. v. M.—Ilelara (A.). The leaves and flowers are eaten by emus.

C. Sturtii R. Br.—Inkutinkuta or ingodingoda (A.). Punti (P.). The yellow flowers are used for decorating the hair or placing in the perforation in the nasal septum.

C. artemesioides Gaudich.—Ingut-inguta (A.). Punti (L.). The flowers are similarly used.

Crotalaria dissitiflora Benth.—Ngilta-ngilta (A.) Sweet material is sucked from the base of the old pods.

Swainsona, sp., near *S. phacoides* Benth. (probably new).—No native name.

S. flavicarinata J. M. Black.—Nakurta (N.). Eaten by emus and kangaroos.

Glycine sericea F. v. M.—Walatjiti (N.). Not used.

Erythrina vespertilio Benth. (Bean-tree).—Innunda (A.). Inninti (L.). Innanti (N.). Young bean trees, only a foot high, have large thickened tap roots descending often a foot or more in carrot fashion. These roots are dug up, heated in a fire so as to loosen the bark which can then be readily peeled off the swollen root, the latter being chewed and the fibre eventually spat out. The seeds (munta-munta, N.)—a beautiful vermilion when fresh, though they soon fade—are used for necklets, and several of these were seen round the necks of children. The wood of the bean tree is very light and is readily worked and used for making shields and larger dishes used for carrying food, water or babies.

Vigna lanceolata Benth.—Alaitja (A.). Wapiti (L.). The long, swollen, somewhat moniliform tap root is eaten raw or cooked.

ZYGOPHYLLACEAE :—

Zygophyllum ammophilum F. v. M. (probably).—Ilknwalja or ilknoilja (A.). The *Zygophyllum* is used in cooking cress *(Lepidium papillosum*—inmurta) and other food plants, *e.g., Convolvulus erubescens* (itnalja, A.; unnilja, L.), but is not itself eaten. It is evidently employed for its moisture content, acting as a kind of steamer. The method of cooking is as follows:—A hole is made in the sand, then small sticks are placed across the hole so as to assume a radiate appearance. Small stones are arranged on the sticks and supported by them. The sticks are set alight, and thus the stones are heated and hot ashes are produced. The hot stones are transferred by the aid of two sticks to the side of the hole. The unburnt sticks are then rejected and the hot stones replaced. A layer of *Zygophyllum* is now placed on the hot stones, then the plants to be cooked, then another layer of *Zygophyllum,* then hot stones again, and finally all is covered with wet sand. When the sand shows a crack the natives know that the plants are cooked. The sand is then brushed aside with mulga leaves, the upper plants removed and the upper layer of *Zygophyllum* thrown away. The cooked plants are now allowed to become cold and are then eaten.

Tribulus occidentalis R. Br. (probably).—Tjilka-tjilka (L.). Tjilkala (N.). The swollen root is cooked and eaten by the natives. Kangaroos eat the plant.

EUPHORBIACEAE :—

Euphorbia Drummondii Boiss.—Murtera-murtera. Not utilised by the native.

E. Wheeleri Baill.—Urtungata (N.). Not used by the natives.

E. eremophila A. Cunn.—Kwarika lilja (A.). Murtu-murtu or mota-mota (N.). The milky juice is used to decorate the chest.

SAPINDACEAE :—

Atalaya hemiglauca F. v. M. (White-wood).—Ilbârâ (A.). The white gum [tung-alba (A.), maku or mako (L.)] is eaten. A witchety grub, which lives in the roots and kills the *Atalaya,* is eaten. The wood is used to obtain shavings, which are mixed with blood, for certain ceremonial purposes.

Ventilago viminalis Hook. (Supple-Jack.)—Kneira (A.). Small spears are made from the stem. The sweet gum is eaten.

MALVACEAE :—

Hibiscus, sp., probably new (with cleistogamous flowers).—Winga-winjamba or winju-winjanimba (N.). Eaten by rabbits and euros.

Sida corrugata Lindl., var. *goniocarpa* F. v. M.—Munta munta (N.). (The same word is apparently used for the seed of the bean-tree, *Erythrina.)* They grind the seeds of this small yellow-flowered mallow and make them into damper.

MYRTACEAE :—

Melaleuca glomerata F. v. M. Ilbilla. Presumably this plant grows in the watercourse at the place called Ilbilla, about 95 miles due west of Mount Liebig.

Eucalyptus dichromophloia F. v. M. (which seems to grade into *E. terminalis* F. v. M. and *E. pyrophora* Benth.). (Bloodwood.)—Arkunga (A.). Arkingi (L.). Many of the bloodwoods in Central Australia bear rough, woody, apple-shaped galls an inch or more in diameter. These are produced by gall-making coccids of the sub-family Brachyscelinae. All those examined during the last three expeditions have been old, and no example of the female coccid inhabiting them has been obtained for identification. It is either *Apiomorpha pomiformis* Froggatt, or else the gall-making coccid, referred to as coming from Tennant's Creek and producing a large gall, which Froggatt (Australian Insects, p. 382) says differs generically from *Apiomorpha.* These bloodwood galls are called araka ngunba or aika ngumba or ngargumba (A.) ; ngantjeri (L. and P.). The galls are collected, smashed open with a stone, and the grub-like female coccid, tjalpa or tjapa (A.), extracted from inside and eaten raw. The mistletoe *(Loranthus Miquelii* Lehm.) growing on the bloodwood is called immalla (A.).

OLEACEAE :—

Jasminum calcareum F. v. M.—Au-ulru au-ulru or olu-ulru-anulru. Not used by the natives.

APOCYNACEAE :—

Carissa lanceolata R. Br. *(C. Brownii* F. v. M.).—Inagitja (A.). Namunburu (L.). The fruit is cooked and eaten.

ASCLEPIADACEAE :—

Sarcostemma australe R. Br. (Milk Bush.)—Ibatji-ibatji or ipatji-ipatji (A.) (ibatja = breast or milk). Ibi-ibi (L.) (ipi, breast). The milk is applied to the nipple (to imitate milk) when the breasts are well developed (after puberty but before pregnancy).

Cynanchum floribundum R. Br.—The fruit and leaves are eaten.

Marsdenia australis (R. Br.) Black.—Altjia (A.). Un-nàla (L.). Ipalu (P.). The flowers, fruit, leaves and roots, but not the stems, are eaten raw or cooked.

CONVOLVULACEAE :—

Ipomoea calobra Hill et F. v. M. ?—Jala (L. and N.), or yala (N.). Two large sweet potatoes (yams) had been collected by Mr. T. Strehlow during his wanderings in the adjacent region and brought to the camp at Mount Liebig. They are probably the same as the yams at Macdonald Downs, whose flowers, collected by Miss Jess Chalmers, were identified by Mr. Bailey in the Botanic Gardens, Brisbane, as the above species. Miss Chalmers gives the native name at Macdonald Downs as anitetjia.

Convolvulus erubescens Sims.—Knelja or itnalja (A.). Anilja or unnilja (L.). The leaves are cooked along with *Zygophyllum* (which supplies the moisture).

Borraginaceae:—

Heliotropium, near *H. tenuifolium* R. Br.—Tjurdi-tjurdi (N.). Seeds made into a damper.

Verbenaceae:—

Clerodendron floribundum R. Br.—Eramata (A.). Irimati (L.). This plant survives through the droughts, and hence its value in such times. The root is cooked in hot sand which is then scraped off with a stick, the root beaten on a stone, the central fibrous or woody part thrown away, and the rest eaten.

Solanaceae:—

Solanum diversiflorum F. v. M. (apparently). (Undulate leaves, large, pale yellowish-green fruit nearly one inch in diameter, on rocky ground.)—Narkutja (A.). Kurra (L.). The outside of the fruits is eaten, the pulp and seeds thrown away.

S., sp. (White fruit.)—Kaitjeri (A.). Fruit eaten.

S., sp. (Very prickly stem, large leaves, and yellowish-green then yellow ovoid fruit).—Warra-kalla-kalu. Not used by man but eaten by euros, kangaroos and wallabies.

S. quadriloculatum F. v. M. (Yellow fruit.)—Uralpa-ralpa or walpa-ralpa (A.). Eaten by kangaroos, but not by man.

S. ellipticum R. Br. (Fruit greyish-green when ripe.)—Randa or ranto (A.). Wanji (L.). Walki (P. and Y.). Fruit eaten when ripe.

Nicotiana suaveolens Lehm.—Ngulbi-ngulga (A.) or ingulpi-ingulba. Resembles "pitjuri," but has sticky leaves and is not used.

N., sp.—What appears to be a new species of *Nicotiana* was brought in from the sandhills and is used for chewing, but is not considered as good as rock pitjuri *(N. Gossei ?)*. It is smaller than the latter.

N. Gossei Domin (probably).—Ingulba (A.). Mangulba (L.). The leaves, stem and roots are used fresh or dried in the sun (the flowers not being used) and are ground up on a stone. They are moistened and then mixed with ashes to make a kind of paste, and the quid so formed is placed behind the ear, and chewed from time to time. The ash in which the moist leaves are rolled is obtained by burning twigs of mulga or some other small acacia, such as *A. ligulata.*

Duboisia Hopwoodii F. v. M.—Monunga (A.). Grows as a bush on the sandhills. Used as an emu poison (by being added to water) but not as a narcotic by the natives.

Scrophulariaceae:—

Stemodia viscosa Roxb.—Kwatjinga unbunamba (A.) (kwatja = water, *i.e.,* water-drinking plant, probably from its growing in moist ground). Pénja-pénja (A. and L.). Added in a bunch to water and used as a strainer for leaves and débris to enable the water to be drunk. Bruised on a stone as a remedy for colds (evidently suggested by the aromatic odour).

Bignoniaceae:—

Tecoma doratoxylon J. M. Black.—Yinbara (A.). Winberri (L.) or winberu (L.) or winperi (L.). Grows amongst the rocks on the hills. The best wood for spears, being long and fairly light. The spears made from it are used for fighting and for hunting euros, kangaroos, etc.

MYOPORACEAE:—

Eremophila Latrobei F. v. M. (Red flowers.)—Ngeling-a or njilinga-a (A.). Minjunga (L.). Ja-njeling-a (N.). The nectar is sucked from the flower.

E. Freelingii F. v. M. (A blue-flowered shrub about 6 ft. high.)—Rutta (A.). On account of the somewhat aromatic scent, used as a pillow for a native with a "sick head" (not one with a "sick belly"). Sometimes placed in the perforation of the nasal septum.

E. longifolia (R. Br.) F. v. M.—Knurunga or narunga (A.). Toilpurpa (P.). Eaten by emus, not by natives.

CUCURBITACEAE:—

Melothria maderaspatana (L.) Cogn.—Ilkurta-ilkurta. Eaten by emus, not by natives.

COMPOSITAE:—

Calotis hispidula F. v. M. (Bindyi.)—Tankara (A.).

Pterocaulon glandulosum (F. v. M.) Benth. et Hook.—Pénja-pénja (A. and L.). Given the same name as *Stemodia viscosa*, which it resembles in stickiness and in possessing an aromatic odour. Used, probably on the latter account, for colds.

Helipterum floribundum DC.—Albut albuta (N.).

Helichrysum Cassinianum Gaudich. (Pink.)—Tjinda-tjinda (A.). The flower is worn in the hair by males as an ornament.

FUNGI-BASIDIOMYCETES:—

GASTROMYCETALES:—

Podaxon pistillaris L. (*P. aegyptiacus* Mont.).—Kopa kopa (A.). This stalked puff-ball has a stem two or three inches long and an elongated oval head which is covered by a shaggy cap which can be readily lifted off, disclosing a mass of purplish-black spores. Holding the base of the stalk in one hand, the cap is removed and the purplish powder is smeared under the nose and across the cheeks and forehead in a thick mass for decorative purposes. The puff-ball is drawn like a brush across the face and is not rubbed backward and forward.

DESCRIPTION OF PLATE V.

Fig. 1. Child wearing a necklace of beans from *Erythrina vespertilio*.

Fig. 2. Powdering the face with the dark spores of the puffball, *Podaxon pistillaris*. The cap of the fungus is being held in the left hand.

ON MASTACOMYS FUSCUS (THOMAS).

By H. H. Finlayson,
Hon. Curator of Mammals, South Australian Museum.

[Read September 14, 1933.]

Plates VI. and VII.

Since the original description[1] of this remarkable rodent, distinguished from all other Australian murids by peculiarities of its molar crown pattern and their great breadth, there have been few references to the genus in the literature.

In 1885 Lyddeker[2] identified the remains of the type species in a collection from the Wellington Caves of New South Wales. In 1896 Waite[3] recorded what he considered to be another species of the genus from Central Australia, but subsequently withdrew[4] the record as a mistaken one, and Troughton[5] has now shown that the material which misled Waite is referable to *Pseudomys (gyomys) desertor*, a form of quite normal dentition.

In 1922 Professor Wood-Jones collected skull fragments from caves in the South-East of South Australia, which in their molars exhibited *Mastacomys* characters, but which proved to differ from the genotype and were subsequently described by O. Thomas[6] as a distinct species, *M. mordicus*, of inferior size to *fuscus*.[7]

The type of *M. fuscus* was obtained from an unspecified locality in Tasmania, and was acquired by the British Museum in 1852, and in the 80 years which have elapsed, no information has been forthcoming as to whether so remarkable a form survived there. The later records, while extending the range of the genus to the southern part of the mainland, have not been followed by any further information as to whether either of the species survives as a living species on the Continent, and fears have been expressed that *Mastacomys* has become extinct over the whole of its range.

The purpose of the present notice is to record the fact that *Mastacomys fuscus* is still extant in Tasmania, and to add some details of a series of specimens taken by the writer in 1931.

These were obtained in Cradle Valley, North-west Tasmania, at an altitude of about 3,000 feet. They were trapped in a complicated labyrinth of runaways in a matted undergrowth of "wire" grass, so dense that in many places the well-beaten pads were completely roofed over by the growth, forming tunnels of considerable extent. Apart from the "wire" grass, the meagre Alpine vegetation of the open heaths upon which the colonies are established, is chiefly comprised

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(1) O. Thomas, Ann. Mag. Nat. Hist., ser. 5, vol. ix., p. 413 (1882).

(2) Brit. Mus. Cat. Fossil Mammalia, i., p. 227 (1885).

(3) Report of the Horn Expedition, Zoology, p. 406 (1896).

(4) Proc. Roy. Soc. Vict., pp. 127-128 (1898).

(5) Records Aust. Museum, p. 293 (1932).

(6) Ann. Mag. Nat. Hist., p. 550 (1922).

(7) The same paper contains a reference to an additional immature specimen of *fuscus*, from Victoria, the history and present location of which is not given. Enquiry at the National Museum, Melbourne, has not cleared the matter, but the search for the specimen has disclosed the presence there of a series of *Mastacomys*, from a Victorian locality. These will be dealt with later by Mr. Brazenor.

of two small boronias *(B. rhomboidea* and *B. citriodora)* and the well-known "button grass" *(Dactyloctenium aegyptium)* characteristic of the high glacial plains of the western parts of the Island. The site is an extraordinarily exposed and shelterless one, the timber line being a quarter of a mile away, and in winter the whole area is frequently covered by a snow-drift several feet deep. Even in midsummer the climate is capricious and often severe, and sleet and icy rains drive up the valley from the west, so that the grass matt is always sodden and frequently awash.

The chief rat colonies of these grassy areas appear to be mixed communities of *Mastacomys* with a rufous heavy-coated highland race of *Rattus lutreola.* The two animals were trapped indifferently on the same runaways, and they are so alike that it was not until the whole series obtained was critically examined that it was seen to be heterogeneous, and examination of the skulls of individuals presenting external anomalies at once showed them to be identical with *Mastacomys.* Both rats are probably quite numerous, but the labyrinths are the chosen hunting grounds of *Dasyurus vivverinus,* and it was not until several days trapping had got rid of the latter that rats began to be caught. *Pseudomys higginsi* is also plentiful in the valley, but it frequents the beech and pine scrubs rather than the open heaths, and its feeding habits, judging by the relative success of varying baits, are quite different from those of the two larger rats.

The five specimens now available prove that the type, contrary to Thomas's statement, was immature, and in several respects the original description may be amended and amplified.

External Characters.

The rat is a large one (Table I.), and of very stout build with short, strong limbs and short tail.

The head is large and the profile strongly arched. The mysticial vibrissae are moderately developed, the longest member being about 45 mm. They are variably coloured, the smaller being wholly black or wholly white, while the larger are black basally and white tipped.

The ear is larger, somewhat broader and more widely spread than in *lutreola.* The marginal portions of both its surfaces are well clad with short adpressed, rich brown hairs (about Ridgway's Vandyke Brown), contrasting with the paler fur of the occiput and nape.

The manus is much as in *lutreola* but smaller, and its digits and palmar structures more delicate. It is clothed above with fine dusky grey-brown hairs, and on the inferior surface of the carpus is a rather conspicuous patch of shining greyish-white hairs. The palm is pinkish or slightly dark pigmented; lighter than the sole.

The pes above is clothed like the manus, but the naked sole is pale lead coloured, similar to, but lighter than, the sole in *lutreola.* The foot, moreover, is longer than in that species and more slender. Its length ranges up to 35 mm. as a maximum, whereas the highest value for the same measurement in a series of 20 *lutreolas* is only 30 mm. In *M. fuscus,* also, the outer interdigital sole pads are duplicated (pl. vi., fig. J).

The tail is short and rather sparsely clothed above with dark blackish brown hairs, and both colour and scutation are exactly as in *lutreola,* but below, contrary to the original description, it is distinctly lighter, the individual hairs being greyish-white. The degree of demarcation of the upper and lower surfaces varies in different individuals but is always apparent, and the feature affords a good distinction from *lutreola,* in which the tail is uniformly dark all round.

The coat is very handsome; long, dense, soft and rather delicately coloured. The general or composite dorsal colour, viewed from a little distance at right

angles, is a dark sooty brown, varying in different individuals from Ridgway's "Natal Brown" to "olive brown." But the colour changes in a striking way with the line of vision, and in an oblique front view it appears darker and in an oblique rear view much brighter and yellower, the differences being due to the varying degrees in which the black contour hairs obscure the fulvous tips of the under-fur

The pelage is made up of a dense silky under-fur averaging 22 mm. long on the dorsum, where it is Ridgway's Blackish Slate for three-quarters of its length and then terminates in a bright yellowish tip, the colour of the terminal band varying from rich "cinnamon buff" to "isabella." The overlay of guard hairs is uniform on the dorsum and is comparatively sparse; they average 32 mm. long, the shaft for two-thirds its length being slate and then thickening to a shining black, tapering point. The lateral surfaces are similar to the dorsal, except that an increasing number of guard hairs are white tipped. The ventral surface is ashy grey externally, obscurely and irregularly tinged with yellow, chiefly at the insertion of the forelimb and on the midline. The ventral coat consists entirely of under-fur much shorter (12 mm.) and coarser than on the back. Basally it is a paler lead colour for two-thirds its length, and then terminates in an ashy grey tip. The external aspects of the limbs are like the sides, and the internal like the belly.

The immature example is more sombrely coloured, owing to the slight development of the yellow tips of the under-fur allowing the basal slate colour to show through. Thomas remarks on the very close similarity of the type specimen, externally, to his *Rattus velutinus*. No specimen of this has been available for comparison, but the immature example referred to above is indistinguishable by pelage characters from *Pseudomys higginsi,* and, as noted, the more rufous adult examples of *Mastacomys* are very close to the less rufous ones of *R. lutreola.* The coat of the latter, however, is distinctly harsher to the touch and shows also some zoning in the distribution of the colour, the head and shoulders being yellower and less rufous than the posterior back, whereas the whole dorsum in *Mastacomys* is very uniform.

SKULL.

Three skulls have been examined, one at about the same dental stage as the type and the others much more advanced, but still by no means aged, judging by the condition of the molar crowns and the sutures. The younger skull, although exhibiting all the dental features on which the genus was founded, shows only imperfectly others which are quite marked and peculiar in the adults, and it is satisfactory to be able to add to the specialization of the molars some structural features as well, which assist in distinguishing the skull from that of all other Australian Muridae.

In proportion to the size of the rat the skull is very large and powerful and its substance dense, and the mandible is massive and strongly sculptured with muscular impressions. In the dorsal view the most notable features are the very large size of the lacrymals, the long parallel-sided and very strongly constricted interorbital region, which is markedly concave above, and the brain case. This is peculiarly shaped, being wide and globular with its anterior portion suddenly expanded and without the gentle tapering forward to the olfactory fossa, general in the Murinae. The temporal ridges are well developed but irregular, and they are not carried forward into the interorbital area in the form of an undercut beading or flange. The temporal slopes of the brain case are rugose, and in both the large examples distinct post-orbital crests are developed. The interparietal is a large element, sharply angulated posteriorly, where it overhangs the occiput as a lambdoid spur.

The general sculpturing of the interorbital and temporal regions is distinctly reminiscent of such Microtine genera as *Arvicola* (pl. vi., fig. C), and is, no doubt, a consequence of a similar enlargement of the masseteric musculature correlated with the specialization of the molars, and the assumption, as in *Arvicola,* of a coarse herbaceous diet of low nutritive value, tough consistence and large volume.(7)

The pterygoid region is generally similar to that of *Rattus;* the mesopterygoid fossa is deep and narrow, the endopterygoid plates bounding it being without curvature and diverging gently backwards. The parapterygoid fossae are wide and shallow but distinctly delimited externally. Their greatest diameter is nearly three times that of the mesopterygoid. The bullae are small, low, oval in outline and very obliquely set to the cranial axis.

The characters of the slightly-worn molars of the smallest skull are exactly as figured by Thomas. They are remarkable not only for their great breadth, but also for the marked obliquity of their laminae and the strong differentiation of the columns and of the cusps which surmount them. With progressive wear the crown pattern of the molars changes considerably, however. The posterior enamel margins of the cusps become less and less conspicuous and the anterior margins more and more so, until at last the tubercular character of the cusps is lost and the cutting structures of the crown partake increasingly of the character of sharp transverse crescentic folds, quite different from the blunted crowns of *Rattus, Pseudomys, Notomys,* etc., and making some approach to the condition in Microtine and Cricitine forms.

The writer regrets his inability to add any intimate details of the habits of this interesting rat, which appears to be filling in the Australian animal economy the niche occupied by the voles in the Holarctic lands. But even had its identity been suspected when the series was taken, the obscure way of life of all the local murids throws one back largely on conjecture. However, further information is much to be desired, and for the convenience of those field naturalists whose excursions may lead them into its habitat, the external features which serve best to distinguish it from the two other rats which are most likely to accompany it, may be thus summarised.

Immature examples resemble *Pseudomys higginsi* in coat colour, but are at once distinguished by their much shorter tails (see dimensions). Adults resemble *Rattus lutreola* in external characters, but are distinguished from that species by: (1) their larger body size, (2) their longer feet, (3) the tail being distinctly lighter below than above.

TABLE I.

Flesh dimensions of *Mastacomys fuscus* in mm., taken from freshly-killed animals.

	1 ♂	2 ♀	3 ♂	4 ♀	5 Im. ♂	"Type" ♀ Recalculated
Head and body	182	182	180	170	136	142
Tail	113	113	110	112	80	94
Pes	35	34	33·5	32	30	31
Ear	22 x 13	22 x 14	22 x 14	20 x 14	20 x 14	17·3* (?)
Rhinarium to eye	24	22	22	—	18	—
Eye to ear ..	19	19	18	—	16	—

*Doubtfully comparable.

(7) Thomas has already drawn attention to the presence of an enlarged caecum.

Table II.

Comparison of flesh dimensions of *Mastacomys fuscus, Rattus lutreola,* and *Pseudomys higginsi,* derived from largest individuals of both sexes obtained, and expressed as a percentage of the head and body length.

	Mastacomys fuscus.	*Rattus lutreola.*	*Pseudomys higginsi.*
Head and body	100	100	100
Tail	62	66	120
Pes	19	18	25
Ear	12 x 7	12·5 x 6·5	17 x 9
Rhinarium to eye	12·5	12	11·5
Eye to ear	10	10	9

Table III.

Skull dimensions of *Mastacomys fuscus* in mm.

	1 ♂	3 ♂	5 Im. ♂	(Recalculated) Type ♀
Great length	41·1	39·8	33·5	36·1
Basilar length	32 ca.	31·7	26·6	—
Zygomatic breadth ..	23·0	21·9	—	21·3
Breadth of brain case ..	16 ca.	16·5 ca.	—	—
Palatilar length	21·5	20·0	—	—
Palatal foramen	—	7·8	—	7·6
Nasals	16·3 x 5·3	15·0 x 5·0	12·1	12·9
Interorbital constriction	4·0	4·5	4·5	4·3
Upper molar series ..	9·9	9·8	8·6	9·9

EXPLANATION OF PLATES VI. AND VII.

Plate VI.

Figs. A, D, E. Views of skull of *Mastacomys fuscus.* Adult ♂.

Fig. B. Dorsal view of skull of *Rattus lutreola* (Adult ♂) for comparison with Fig. A.

Fig. C. Dorsal view of skull of *Arvicola amphibius* (after Hinton). For comparison with Fig. A.

Figs. F, I, and J. Soft palate, right manus and pes, respectively, of *Mastacomys fuscus.* Adult ♀.

Figs. G and H. Right manus and pes, respectively, of *Rattus lutreola.* Adult ♂.

Plate VII.

Cradle Valley, North-west Tasmania. A view from the north, showing features of the country in which *Mastacomys fuscus* still survives. Photo by H. H. F.

TANTANOOLA CAVES, SOUTH-EAST OF SOUTH AUSTRALIA: GEOLOGICAL AND PHYSIOGRAPHICAL NOTES.

By NORMAN B. TINDALE, B.Sc.

[Read September 14, 1933.]

INTRODUCTION.

During May, 1931, Messrs. H. M. Hale (Director of the S.A. Museum), H. Condon (Museum Cadet), and the writer spent two weeks in an examination of the newly-opened scenic cave near Tantanoola (140° 29′ east long. × 37° 43′ south lat.; fig. 1), from which various odd mammal bones had been recovered by previous visitors, notably by Dr. C. Fenner and Dr. T. D. Campbell. The objects of the visit were to obtain series of the fossils for study and to examine the field evidence as to the history of the site; the following account summarises the physiographical and geological notes made. Messrs. V. A. Cram (Manager) and C. Lane (Caretaker), of the caves, gave every assistance in the work of removing the fossil material, and we thank them for their courtesy and co-operation. Several caves were examined in detail. They were found to have been formed under widely varying conditions. Field symbols, A, B, etc., were arbitrarily given to the sites as work proceeded, and owing to the numerous specimens obtained in them, and so marked, it appears desirable to retain those indications.

GENERAL DESCRIPTION OF CAVES.

Cave A, situated in the cliff at Up and Down Rocks (Section 213, Hundred of Hindmarsh), is a solution cavity in Tertiary dolomite limestone, and is abundantly supplied with stalactitic and stalagmitic deposits. The entrance to it has been recently artificially enlarged to permit of its exploitation as a tourist attraction. This solution cave is subsequent to and partly incorporates an earlier cave, formerly present in the same cliff face. The earlier cave was excavated horizontally by marine action and was then completely filled by a sequence of marine and shore deposits together with various bones, after which the whole became infiltrated with lime to such a degree as to resist solution even more than the surrounding dolomitic limestone.

The formation of the solution cave by the passage of waters from above is a distinct event, and the new cave developed for a long time with only meagre direct access to the atmosphere, thus pavement deposits beneath the stalagmitic floor consist of broken stalactites, red cave earth, and a few fossils and flint pebbles derived from the earlier bone deposits. Superficial traces of bats and opossums indicate that direct communication with the exterior has only relatively recently been established. This communication was, however, anterior to a period of volcanic activity in the neighbourhood, for there was a talus of volcanic ash at the entrance. The sketch section (fig. 2) summarizes the relationships between these two series of deposits, the details of which are given in the following paragraphs.

THE MARINE AND SHORE DEPOSITS OF CAVE A.

Fig. 4 is a diagrammatic representation of a natural section of the marine and shore deposits revealed on the vertical south-western wall within cave A. It represents a completely filled cave some six feet high in which the following consolidated deposits are represented:—*(e)* Fine cemented wind-blown shell sand with numerous rodent and bat jaws; *(d)* Coarse wind-blown shell sand with

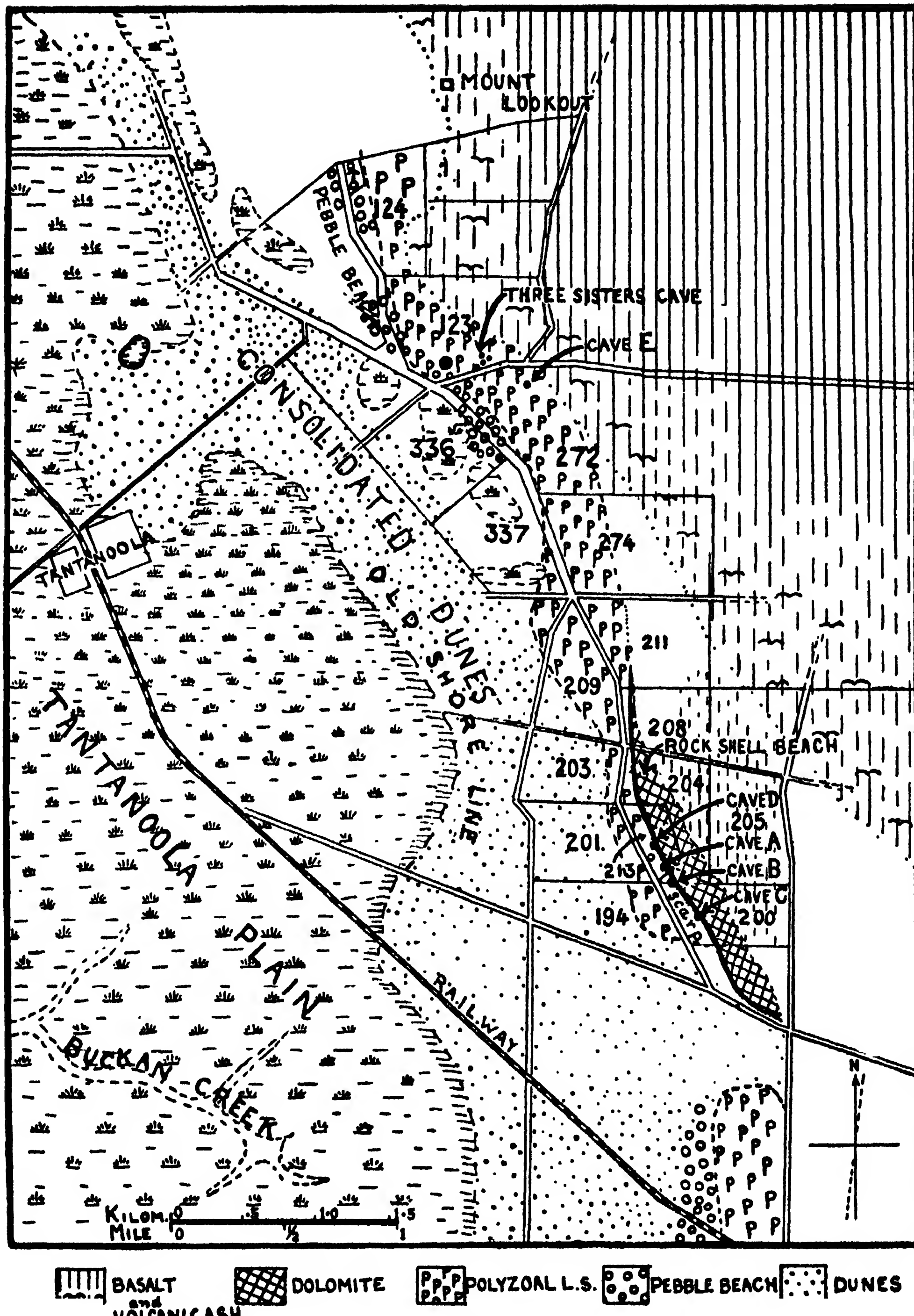


Fig. 1.

Sketch Map of portion of Hundred of Hindmarsh, South-East of South Australia.

occasional bones; *(c)* Bone breccia containing remains of giant kangaroos; *(b)* Beach sand with some clay, occasional large, rounded flint pebbles, fine gravel, shells, also teeth and other remains of seals; *(a)* Flint pebble bed.

The shell fauna represented includes identifiable examples of *Patella ustulata* and *Fusinus australis.*

The mammalian remains have been identified by Mr. H. H. Finlayson, who intends to give a further account of them in a separate paper. They are all mineralized and cemented in shell limestone. They include recognisable remains of:—*Macropus raechus* Owen, a giant kangaroo. *Sarcophilus? Arctocephalus. Phascolomys?* Ulna and part of tibia of a very large species. The small mammal fauna of the uppermost parts *(e)* of the bone breccia includes:—*Rattus, Hydromys, Trichosurus.*

Ramifications of this system of marine caves survive in all stages of dissection in various parts of the present cave, and have yielded much fragmentary bone material for our collection.

The Solution Cave Deposits of Cave A.

As already described, these consist of abundant stalagmitic floors containing red cave earth and superficial remains of mammals.

The larger stalactitic columns, some of which are up to four feet in least diameter, show healed fractures due to subsidence and to lateral movements of the order of six inches. There was a talus near the small original entrance consisting of volcanic ash, dust, guano, and the bones of small mammals, but this was largely disturbed during the opening up of the cave and is now buried under an artificial ramp and pavement which yields access to the floor of the main cave. A thorough examination of all accessible ramifications of this cave brought to light many examples of the recent fauna; in this search we were assisted by the caretaker's children, who nonchalantly crawled along low passages quite inaccessible to adults. The principal remains, as identified by Mr. H. H. Finlayson, are:—*Trichosurus, Isoodon, Phascolomys, Dasyurus,* and a large unidentified rodent. *Trichosurus, Dasyurus,* and *Isoodon* bones were also sieved from a part of the volcanic ash of the talus which had remained relatively undisturbed during the excavation of the artificial opening to the cave.

Site B.

This is situated some 30 yards further south-east along the Up and Down Cliff, approximately at the boundary of the Section. It consists of a small weathered seaward face of a debris-filled marine cave, similar to the one revealed in transverse section in cave A. A few fragments of fossil bone were recovered.

Site C.

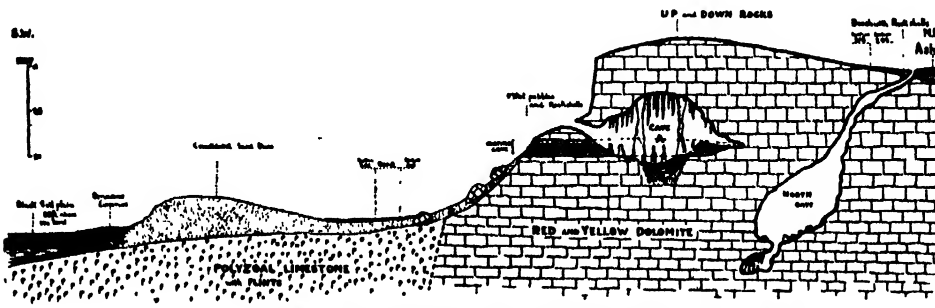
This is a superficial cavity in the face of the cliff situated some sixty yards south-east of site A (on Section 200). It is a hole extending down for twelve or fourteen feet at a steep angle. The entrance was artificially enlarged during a search for further exhibition caves. When first located it was completely filled, from floor to roof, with black volcanic ash, which, on sieving, has yielded a fair percentage of recent animal bones. These consist of *Sarcophilus, Phascolomys, Pseudochirus, Isoodon, Phascogale, Canis familiaris, cf. dingo.* In addition some very recent bones of *Macropus, Wallabia* and *Trichosurus* were present near the entrance. The bones were not confined to a particular layer but occurred at intervals through the ash. The question of direct volcanic deposition *versus* partial redeposition of the ash by water action is uncertain; probably both factors were at work. Some of the animals found in the ash are of burrowing habit.

Site D.

This is a low hole extending into the cliff for approximately four yards, at a point some fifty yards north-west of site A. It contained about a foot of dry dust, some ashes and charcoal and some mammalian remains, including dark-stained but apparently recent bones of *Canis familiaris dingo, Wallabia, Thylogale, Trichosurus, Pseudochirus, Dasyurus maculatus, Bettongia, Isoodon,* and *Phascolomys.* The site was evidently not suitable for native occupation, and the charcoal, etc., present may be the remains of fires employed in smoking out rock wallabies, etc.

North Cave.

The only other site examined in the immediate vicinity of the main cave is situated on the top of Up and Down Rocks. It is locally known as the North Cave. The entrance is a small hole no larger than a wombat burrow, situated on Section 204, within a few yards of the boundary with Section 213. At the surface is a broad expanse of consolidated lime-sand beach with rock shells overlain by a variable thickness of black volcanic ash soil which in places is up to ten feet in depth. A section of the ash beds is well shown in an excavated pit a few yards further to the north-east.



SKETCH SECTION - ½ mile - UP & DOWN ROCKS - SECT 213 HINDMARSH SHOWING VICINITY OF TANTANOOLA CAVES.

Fig. 2.

The entrance slopes steeply down for some twenty feet, after which it opens into a series of narrow chambers of great length and vertical height, containing masses of broken stalagmite. Access to the base is gained by precariously descending over masses of loose limestone which have been shed from the roof of the cave. Rough estimations suggest that the cave is over one hundred feet in depth. The walls, where sounded, proved to be composed of compact dolomitised limestone, reddish above, yellowish near the base. No significant bone specimens were secured, but the great local thickness of the dolomite was demonstrated.

The Glencoe Road Sites.

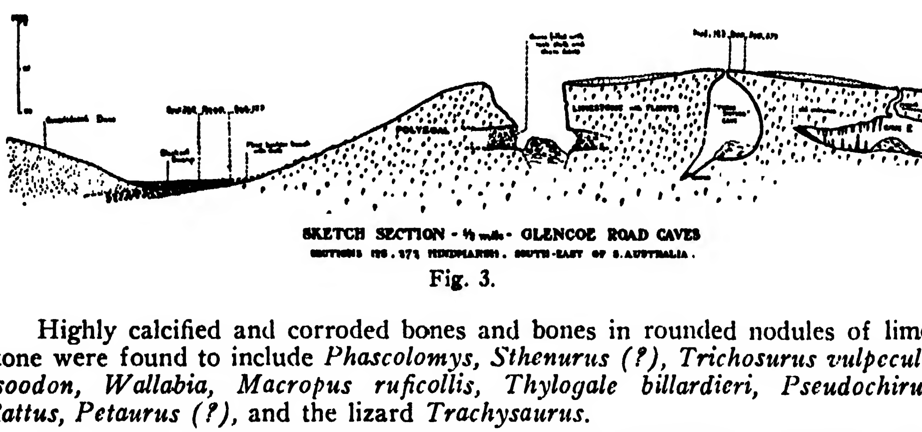
Cave E.

This is a cave of relatively recent origin, excavated in a soft polyzoan limestone which contains flints. It is situated on Section 272, Hundred of Hindmarsh, within 20 yards of the main Glencoe Road (fig. 3). Although partly due to solution, the main ramifications run parallel to each other with rectangular connecting passages, in such a manner as to suggest solution along definite fracture planes. The present entrance is a circular trap hole two feet in diameter descending in spiral fashion for some fifteen feet. Bones of numerous recent animals, including

those of sheep, are represented among the victims of the natural trap. The floor of the lower parts of the cave is wet, and bones lying there are heavily impregnated with carbonate of lime. Elsewhere the floor of the cave is covered with limestone pebbles, the nucleus of each of which is an animal jaw or other bone. The entrance is marked by a mound of black volcanic ash soil with fresh bones. Stalactitic growths are abundant but are all of comparatively small dimensions, confirming the general impression of youthfulness.

At the south-western extremity of the cave, where roots from trees on the surface pass through the cave, the floor is higher and dryer than elsewhere. A yellow sand talus exists here which has been derived from an entrance now sealed. The bones present in this sand are fresh in appearance but are evidently somewhat earlier in date than some of the others, because the talus includes no apparent traces of the volcanic ash which occurs in the talus beneath the present-day entrance. The remains in the earlier talus consist of *Perameles, Isoodon, Trichosurus, Dasyurus,* a very large *Rattus, Wallabia, Thylogale,* and *Macropus.*

The floor was sounded to a small depth at a spot five or six yards south-west of the present entrance, and bones of *Macropus, Wallabia, Trichosurus,* and *Thylogale* were then found under two layers of floor travertine. On various parts of the floor of the cave there were present *Wallabia, Isoodon,* a big rodent, *Bettongia, Phascogale, Potorous, Rattus, Trichosurus,* and *Dasyurus,* and remains of the lizard *Trachysaurus.* Where the bones were on moist pavements they were strongly impregnated with lime, elsewhere they were fresh-looking.



SKETCH SECTION - ½ mile - GLENCOE ROAD CAVES

Fig. 3.

Highly calcified and corroded bones and bones in rounded nodules of limestone were found to include *Phascolomys, Sthenurus (?), Trichosurus vulpecula, Isoodon, Wallabia, Macropus ruficollis, Thylogale billardieri, Pseudochirus, Rattus, Petaurus (?),* and the lizard *Trachysaurus.*

Very recent material included *Dasyurus, Isoodon, Trichosurus, Bettongia (?), Perameles,* a large *Rattus* (predominant), a smaller rodent, *Macropus giganteus, Thylogale, Phascogale,* and *Wallabia.* Most of these, including the bones of a sheep, were found on the black soil talus at the entrance; other recently trapped animals had evidently wandered some distance before expiring, and account for fresh bones in places remote from the entrance.

Other Sites.

Two other caves exist in the vicinity. The Three Sisters Cave, situated alongside the road on Section 123, was not entered. It is a natural trap with three mouths. Entrance can only be gained by a 40-foot clamber down a roped ladder. One hundred yards further west there is a large circular pit, formed by the collapse of a cave of large dimensions. This is situated near the margin of the older seashore, and the breaking in of the cave has revealed sections of marine caves filled with rock shells and shore debris. This material can be definitely

associated with the flint boulder beach with shells which occurs along the roadway between Sections 123 and 335. The mode of origin is similar to that of the marine caves at Up and Down Rocks, and is discussed in some of the following paragraphs.

Geological Notes.

The interpretation of the history of the Tantanoola caves necessitates some examination of the geology of the surrounding country. The attached sketch map and sections (figs. 1-3) illustrate the principal features.

Up and Down Rocks is a scarp which appears to mark the position of an old fault line traceable in a west of northerly direction for about one and a half miles from the southern corner of Section 200 (Hundred of Hindmarsh), after which it is lost beneath consolidated dunes of wind-blown lime-sand and the ash beds of the basalt flow which forms the Mount Burr Range. The rocks down-thrown to the west consist of polyzoal limestone of Tertiary age, containing irregular masses of blue and grey flint. The up-thrown beds consist of massive pink- and yellow-dolomites and dolomitised limestone, also of Tertiary age.

The fault scarp has been incidentally revealed by marine erosion which has removed some of the polyzoal limestone near the line of the fault, thus throwing the dolomite into relief as a vertical wall and a slope standing about one hundred feet above the broad Tantanoola Plain, which here lies to the south-west. The Tertiary polyzoal limestone is present in a quarry near the foot of rocks at the northern end of the Section and has been described by Jack.(1)

The line of the fault scarp between Sections 200 and 211 and the line of the road to Section 124 marks the position of an old marine terrace upon which are still strewn the products of marine denudation and deposition in the form of beds of shells containing rounded flint pebbles (up to 30 lbs. in weight). These flints have been derived from the polyzoal limestone, by erosion. This marine cycle was apparently responsible for the cutting of the earlier cave A and for the deposition of the marine debris in it (fig. 2). Similar cave erosion and filling was carried out at Section 123 (fig. 3), where caves now filled with rock shells and shore debris may be seen in sections in the cavity formed by the collapse of a newer solution cave. Estimations, based on the fact that the elevation of Tantanoola Railway Station is 83 feet, suggest that this marine terrace is situated between 140 and 160 feet above present sea level. The immediate front of this shore line is marked between Sections 209 and 124 by a line of swamps which further north coalesce to form a long swamp lagoon. West of this line of swamps there are many dune-like hills composed of fine quartz- and shell-sand, cemented with lime, forming a belt up to half a mile in width and ranging from 20 to 40 feet in elevation. These dunes represent the shoreward debris formed during a still more recent period of marine stand-still at a height above sea level but little above that of the Tantanoola Railway Station (83 feet). The margin of this newer marine terrace can be traced north-west and south for some miles. Northward it appears to be continuous with the line of consolidated dunes forming West Avenue Range. At the level of the margin of the Tantanoola plain (*c.* 80 feet above sea level) there are beds of estuarine limestone with lagoonal shells (*Rissoa,* sp., and *Calliostoma nobile* Phillipi), above which there is the rich black soil, largely of volcanic origin, of the swamp plain.

In order to further elucidate the history of this site an examination is necessary of the wonderful series of successive sand ridges which mark the positions of former shore lines of the South-East of our State. In the following paragraphs a few general observations are given, derived partly from a study of the extensive series of bench marks recorded in the maps made by the South-

(1) Jack, R. L., Geological Survey of S. Aust., Bulletin 10, 1923, p. 45.

Eastern Drainage Commission, to a small degree from personal examination, and otherwise from the extensive literature relating to the subject. A possible interpretation of these facts will be given in a separate section of the paper.

This remarkable series of foreshores has been frequently described, *e.g.*, Tenison Woods,[2] Howchin,[3] and Fenner.[4]

The principal "ranges" and the relative heights of their probable foreshores above present sea level are given below. In the case of the older terraces doubt exists as to the exact level of the shoreline, the figures in brackets indicate the

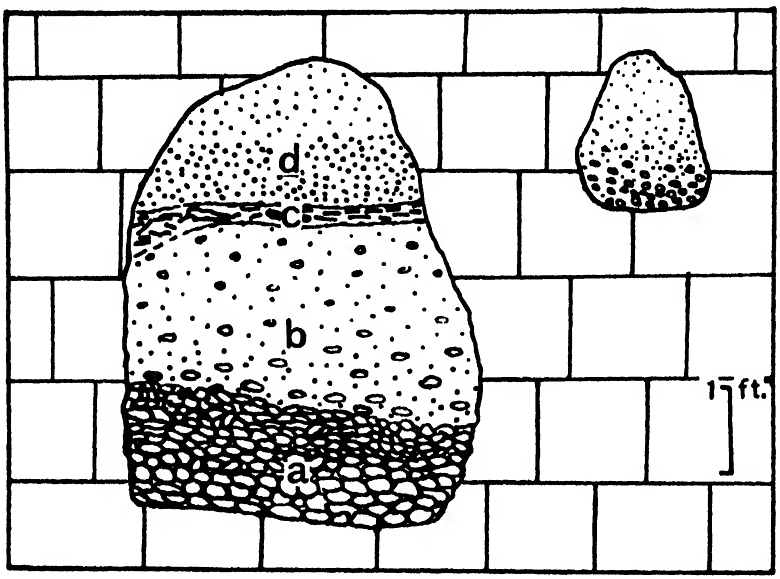


Fig. 4.
Transverse Sections (natural) of filled Marine Cave in Dolomite, as seen on wall of Cave A, Tantanoola.

absolute minimum as limited by the general level of the floor of the corresponding planes of marine denudation. The uncertainty of these figures is chiefly due to a lack in the records of the drainage survey; as a rule only the heights of the depressions to be drained were recorded in detail. Two or even more dune ridges may be present on the one foreshore. A section from the vicinity of Beachport north-eastward to the Naracoorte Range north of Glen Roy shows, in descending order, the following principal terraces:—

Naracoorte Range[5] - -	250 feet	(190 feet)
Cave Range - - - -	200 „	(160 „)
East Avenue Range - - -	150	(120
West Avenue Range - - -	90	(80
Reedy Creek Range - - -	65	(50
Woakwine Range - - -	25	(10

(2) Woods, J. Tenison, Geological Observations in South Australia, London, 1862.
(3) Howchin, W., Geography of South Australia, revised ed., 1917, p. 106.
(4) Fenner, C., South Australia: A Geographical Study, Melbourne, 1931, p. 59, *et seq.*

(5) The higher figure for the Naracoorte Range is given on the authority of a statement by Sir T. W. Edgeworth David, *vide* Explanatory notes to . . . a new geological map, Sydney, 1932, p. 96.

The earliest of these marine terraces appears to be continued north-westward in the Marmon Jabuk Range and to be cut across by the Murray River at Fromm Landing (Section 50, Hundred of Ridley), where the section depicted in fig. 5 may be seen. At Fromm Landing the Post-Pliocene calcareous dunes containing fragments of marine shells are met with at the elevation (measured by aneroid) of between 200 and 240 feet above the river (which is here only a few feet above sea level). They rest on a relatively great thickness of red clay, which itself lies upon the characteristic "*Ostrea* Beds," generally considered to be Lower Pliocene in age.

Further to the north, *e.g.*, at Swan Reach and Blanchetown, the Pliocene "*Ostrea* Beds" are the uppermost marine horizon and appear on the surface of the

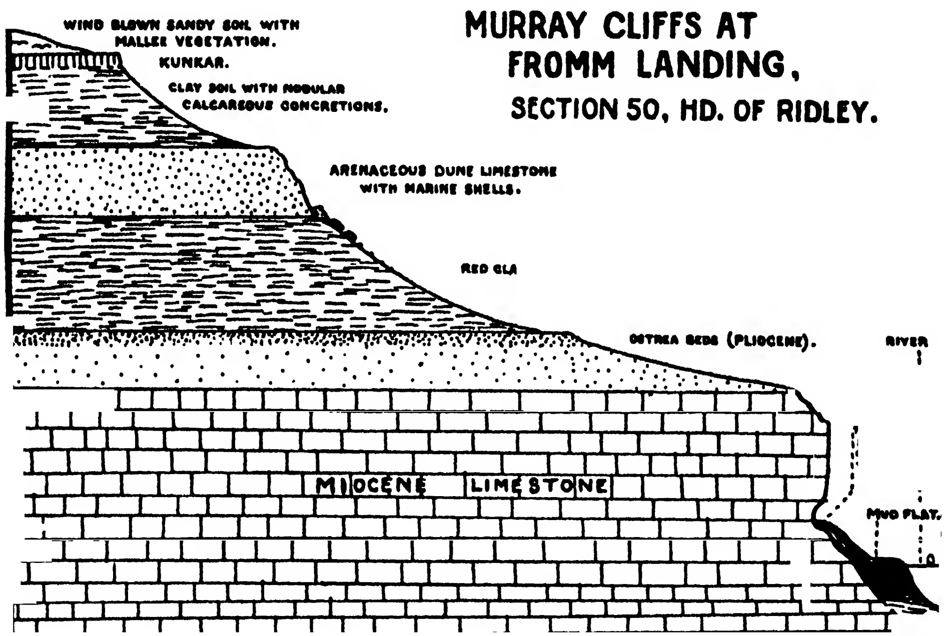


Fig. 5.

Section of Murray Cliffs at Fromm Landing, Section 50, Hundred of Ridley.

plateau. They have been identified at many places between Swan Reach and Morgan. The north-western extensions of marine terraces younger than the Naracoorte have not yet been traced in detail. One of the youngest of them may be represented approximately two miles north of Wellington, on the main road to Tailem Bend.

Discussion.

Before entering into a discussion of the significance of the marine deposits at Tantanoola it seems desirable to briefly mention the problem of the nomenclature of cherts, flints, and allied siliceous deposits, especially as it applies to the rocks of the South-East.

According to a recent authority[6] there is very little beyond a nomenclatorial difference between chert and flint. "The interior of a chert nodule is usually solid,

(6) Milner, H. B., Sedimentary Petrography, London, 1929, p. 320.

often a fossil shell nucleus or aggregate of fossil particles; the interior of a flint on the other hand may be quite hollow, and from it a siliceous powder, full of sponge spicules, etc., may often be obtained." Sponge spicule filled cavities are a noteworthy feature of our Miocene siliceous boulders. The tendency to assume, with weathering, a pale porcellanous aspect, and the distinct conchoidal fracture, are other features which suggest that we are correct in using the term "flint" in preference to any other.

Fenner[7] records similar flint pebbles from the stratified tuffs of Mount Gambier, and tentatively derives them from Tertiary limestone beds. Evidence at Tantanoola indicates that these pebbles are derived by erosion from the polyzoal limestones, in which the flint occurs as irregular masses. The polyzoal limestones are of Miocene age. It seems likely that some, if not all, of the worn flint pebble beds were derived from the erosion of the limestone in Post-Tertiary times.

As a digression it may be remarked here that these flint boulders supply the principal materials employed by the South-Eastern aborigines in the fashioning of their stone weapons. Implements of superficial sites along the present-day coast are deep blue or grey in colour; the flints found on the older sites, especially those somewhat inland from the present coast, show differences in technique and are frequently altered to a white colour by the solution of portion of the opaline silica.

The presence in the South-East of caves with fossil bones has been known for a long time. In the vicinity of Mount Gambier they were noted by Burr[8], who states:—"There are . . . caverns which contain the bones and teeth of animals of larger size than those which are at present living in this part of the continent of New Holland. Some of them belong to gigantic kangaroos; others apparently to species of dogs." The "dog" bones referred to may belong to species of seals. They were not critically examined and the specimens cannot now be traced.

The presence in the earlier deposits of cave A, at Up and Down Rocks, of what appears to be a Pleistocene fauna, characterised by the bones of the extinct giant kangaroo, *M. raechus,* introduces an interesting problem in the correlation of the coastal terraces of the South-East of our State, with one of which this shoreline deposit is associated.

The formation of the series of coastal dunes in the South-East has been considered by some geologists to have taken place within a period loosely termed "Recent." On the basis of the new evidence available, it is suggested that this period will more probably be shown to extend over a period embracing Pleistocene and Recent times. There is remarkable correspondence between the successive "Ranges" and the corresponding marine terraces of stable foreshores in other lands.

From a study of the foreshores of various continents at places believed to be relatively stable, it has been frequently deduced that during Pleistocene and Recent times there have been marked variations in sea level. Cooke[9] has summarized some recent references to this subject, and has given his results of the study of the eastern coast of the United States.

In the accompanying diagram (fig. 6) an attempt has been made to compare the principal terraces of the South-East of South Australia with the

(7) Fenner, C., Trans. Roy. Soc. S. Austr., vol. xlv., 1921, p. 179.

(8) Burr, T., Remarks on the Geology and Mineralogy of South Australia, Adelaide, 1846, p. 18.

(9) Cooke, C. W., Correlation of Coastal Terraces, Journal of Geology, xxxviii., 1930, pp. 557-589.

coastal terraces of the south-eastern United States, in the hope that it will serve as a basis for more serious discussion of the problem.

The acceptance of a theory connecting the South-Eastern marine terraces with Pleistocene variations of sea level would involve the assumption that the successive "ranges" are not the result of a simple and orderly recession, perhaps marked by "stand stills" during which the sand dunes were formed, but that there have been successive advances and retreats of the sea. If the raised terraces attest to the glacial high tides, there should be evidence for the corresponding low tides.

Chapman[10], in the records of the Sorrento Bore, has shown that for an area to the south-east of the present one there have been downward movements of

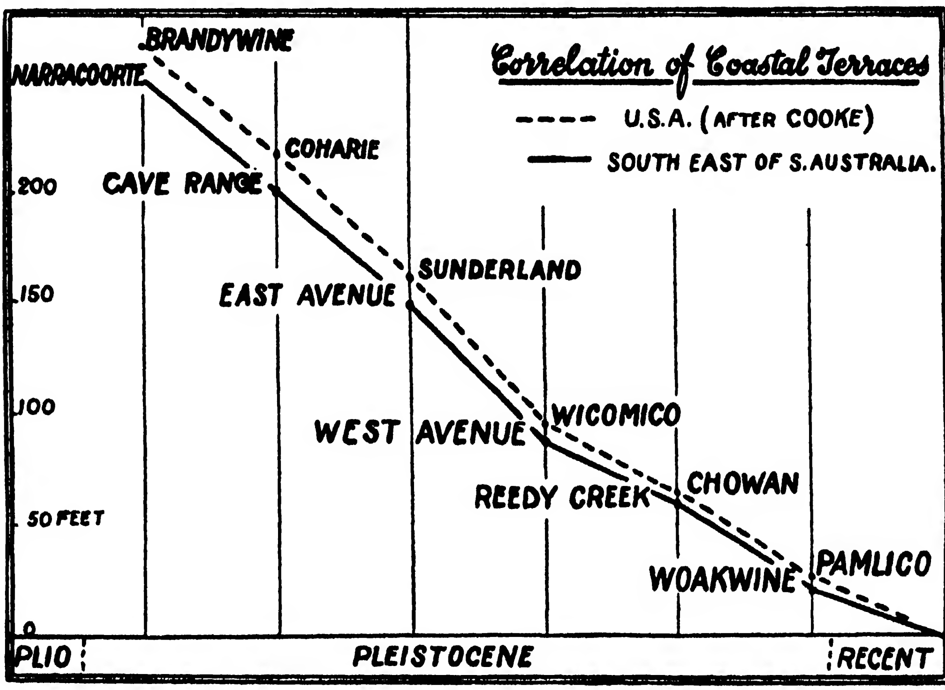


Fig. 6.
Correlation of Coastal Terraces, U.S.A., and South-East of South Australia.

the land in Tertiary time, but that this sinking has been relatively slow and therefore not very appreciable during the shorter interval of Pleistocene and Recent times. This is indicated by the fact that at least four (probably five) low water stages of sea level have occurred during the Pleistocene Period, permitting the deposition of dune deposits alternately with the marine ones.

The evidence from bores along the coastal regions in the Murray Basin, *e.g.*, at Tintinara,[11] also offers hints of such variations, but the facts have not yet been fully marshalled. The present discussion serves merely to draw added attention to a problem which will require much co-ordinated knowledge and research before positive dicta can be made.

Factors leading to the formation of these extensive calcareous dunes along our South-East coast may be:—(1) The presence of waters of the Murray heavily

(10) Chapman, F., Records of the Geological Survey of Victoria, v., 1928, pp. 1-195.

(11) Tate, R., Trans. Roy. Soc. S. Austr., xxii., 1898, pp. 67-68.

laden with calcareous salts. (2) The impingement of great food-laden marine currents from the west encouraging the development of a rich molluscan fauna to utilize this calcareous waste. (3) The milling action of the open Antarctic Ocean upon the abundant calcareous remains of animal life provided by these conditions.

Factors leading to the preservation of this remarkable series of dune ranges are perhaps:—(1) The absence of erosion through lack of primary drainage (in part due to the minor scale of crustal warpings in Pleistocene and Recent times). (2) The absence of highlands. (3) The dominantly subterranean drainage due to the underlying calcareous strata. (4) The calcareous nature of the dunes, which has led to their rapid consolidation and consequent fixation.

These factors seem to have assisted in preserving a youthful aspect which other facts belie. Pressing desiderata are the ascertaining of more detailed information regarding the elevation above sea level of the earlier dune "ranges" of the South-East and the collecting and study of the shell faunas both of the ranges and of the plains between them. The artificial draining of the swamplands has, in places, exposed excellent subsurface sections which show, by alterations from estuarine to marine, followed by further estuarine and lagoonal conditions that the detailed interpretation of the sequence of events may be complex.

One of the general results of the study of Pleistocene marine terrace faunas is the indication that raised beaches on stable foreshores frequently bear evidence of "warmer" climates than that at present existing in these places. Preliminary studies in South Australia seem to indicate that the "*Arca*" raised beaches of the northern portions of the coastline of South Australia are of early Recent or very late Pleistocene date, and that it may be possible to compare them with the Pamlico (Mid-Wisconsin) terrace of the eastern United States, with the London 20-feet terrace, and the newer raised beaches of Spitzbergen, all of which give indications of warmer climates than at present existing in the adjacent waters.

Howchin,[12] who has described many occurrences of this "*Arca*" terrace in South Australia, has already pointed out that the foraminifera associated with the "Arca beds" are of "warmer" type. Studies of the fauna of the Woakwine raised sea floor and terrace (15-25 feet) suggest that the degree of warming was not sufficient there to enable the "*Arca*" fauna to become dominant, although occasional examples may occur. The dominant forms of the terrace are *Chione* (several species). Recent work on the climatic zoning of littoral shells has shown (*e.g.*, Elton and Baden Powell)[13] that many differences are to be expected when marine terraces are traced from latitude to latitude. Bearing this in mind, it is possible to suggest a relatively uniform 20-25-feet terrace extending along the whole of the stable portions of the sea front of South Australia, disturbed only by minor movements in the unstable down-faulted region of St. Vincent Gulf. Fig. 7 (upper) suggests the distribution and zoning of the dominant forms of the 20-foot terrace.

With the onset of the cooler conditions characteristic of the present phase (fig. 7, lower) a zone characterised by a great abundance of *Donax deltoides* has moved north, replacing the *Chione* zone (as seen in sections in the Coorong), while the *Chione* fauna, in turn, has moved north and now finds its climatic equivalent in the warmer gulfs. The *Arca* zone has disappeared or doubtfully survives north of Streaky Bay, where living *Arca* has been taken.

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(12) Howchin, W., Geology of South Australia, 2nd ed., 192?, p. 254 (also consult bibliography).

(13) Elton, C. S., and Baden Powell, D. F. W., Geological Magazine, lxviii., 1931, pp. 385-405.

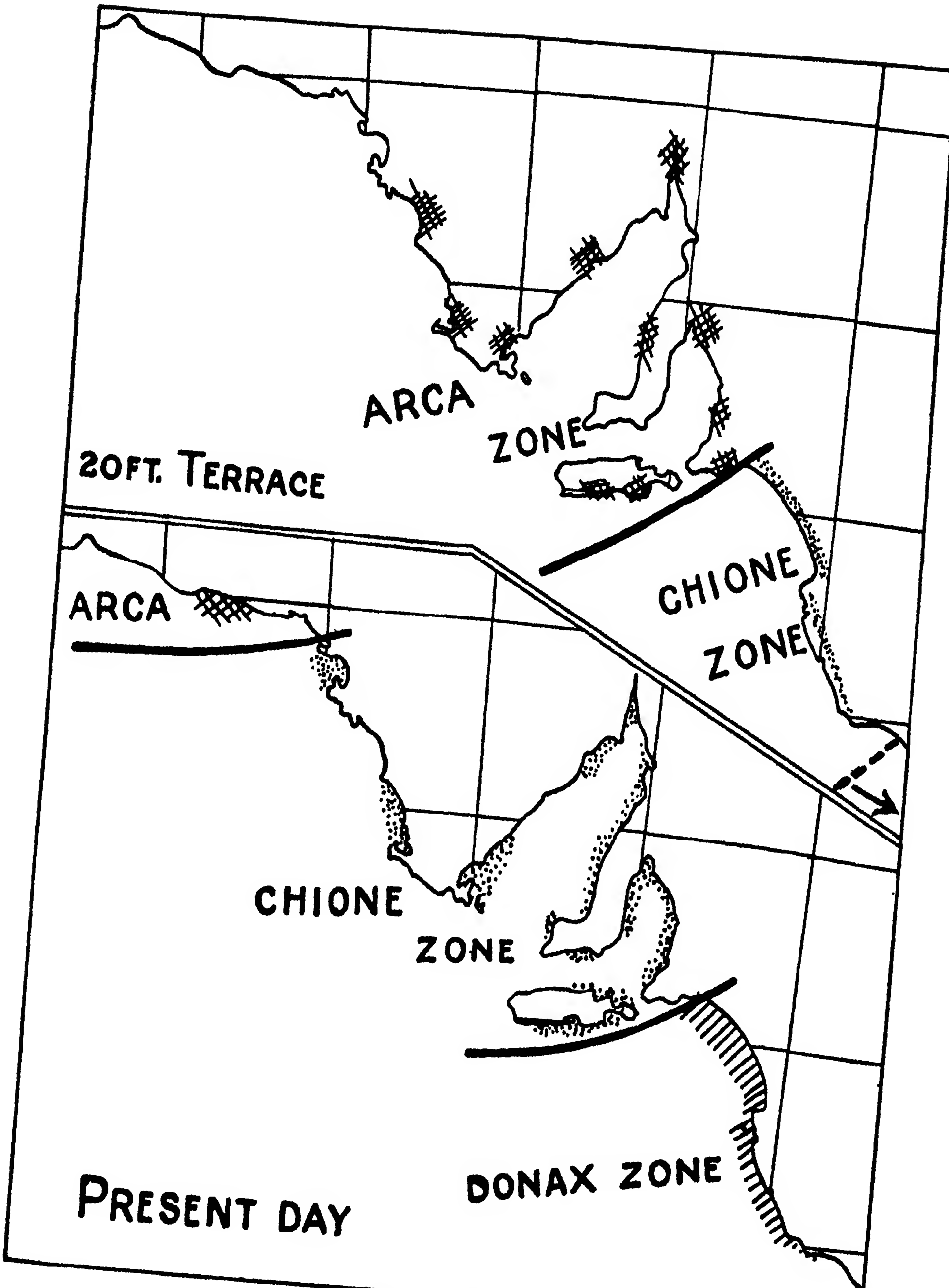

Fig. 7.
Maps of the Coastline of South Australia, showing distribution of Dominant Shells of the present and "20-foot" Shore Lines.

Man must have entered Australia some time during the latter part of the period when these dunes were being formed. The laws of mammalian dispersal suggest that once he had attained the continent he would rapidly (from a geological point of view, almost instantaneously) have spread to all parts of his extended domain. Thus a careful scrutiny of the series of marine beaches from the most recent backward is likely to eventually reveal to us an indication of the period of man's first advent in South Australia, and then enable us to interpret it in terms of physiographical changes. Hence the interest which the general problem may prove to have for the anthropologist.

Appendix.

Shell fauna of the Woakwine Terrace, as identified by Mr. B. C. Cotton:—

Brachydontes crosus Lam.
Ostrea sinuata Lam. *(angasi)*.
Pecten bifrons Lam.
Mytilus planulatus Lam.
Cardium tenuicostatum Lam.
Chione gallinula Lam.
Chione scalarina Lam.
Chione corrugata Lam.
Tapes galactites Lam.
Nacella parva Angas.
Astralium aurea Jonas.
Phasianella australis Gmelin.
Clanculus dunkeri Koch.
Monodonta constricta Lam.
Monodonta odontis Wood.
Cantharidus lehmanni Menke.
Cantharidus conicus Gray.
Capulus conicus Schuh.
Polynices conicus Lam.
Coxiella gilesi Angas, a thassaloid shell.
Bittium granarium Kiener, lagoonal shell.
Bittium lawleyanum Crosse, lagoonal shell.
Nassarius pyrrhus Menke.
Nassarius pauperatus Lam.
Pyrene austrina Gaskoin.
Cominella eburnea Reeve.
Cominella lineolata Lam.
Fusinus australis Quoy.
Fasciolaria australasia Perry.
Conus anemone Lam.
Bullaria botanica Hedley.

The absence of *Donax* and the dominance of individuals and species of *Chione* is characteristic.

The above series was collected at a point 6·1 miles from Robe on the road to Beachport, beside Section 187, Hundred of Waterhouse. The marine terrace ranges from nine feet above sea level on the floor to 28 feet on the former beach; above this the "Range" is composed exclusively of consolidated calcareous dune sands.

Summary.

This paper records the occurrence of mammal bones in several caves at Up and Down Rocks, South Australia. In addition to several finds of recent animals, the fossilized remains of Pleistocene mammals, including *Macropus raechus* and a seal, were obtained in a cave on the foreshore of an old marine (160-ft.) terrace.

Evidence for the Pleistocene origin of the "Ranges" of the South-East of South Australia is discussed and tentative comparisons made with the coastal terraces of the south-eastern United States.

Some details relating to the fauna of one of the most recent (Woakwine) terraces are discussed, and some general evidence is brought forward.

ADDITIONS TO THE FLORA OF SOUTH AUSTRALIA.

No. 31.

By J. M. Black, A.L.S.

[Read October 12, 1933.]

Plates VIII. and IX.

Gramineae.

**Pennisetum macrourum*, Trin. This stout ornamental South African grass was found by Prof. Cleland growing along the River Onkaparinga, 6 miles above Clarendon.

**Lepturus pannonicus* (Host) Kunth. Greenock (near Nuriootpa).—Spain; lower Danubian States; Southern Russia. Differs from other species of the genus in having 2-flowered spikelets. In general appearance it resembles *L. cylindricus.*

Leptochloa digitata (R. Br.) Domin, in Bibl. Bot., Heft 85 : 379 (1915), instead of (R. Br.) J. M. Black, Fl. S. Aust., 85 (1922).

Spinifex inermis, Banks et Sol. in Hook. f. Fl. Nov.-Zel. i., 292 (1853), in place of *S. hirsutus*, Labill. (1806). The change is necessary because this grass was first named *Ixalum inerme* by G. Forster in his Prodromus, which was published in 1786.

Iseilema.

This genus, originally based by Andersson on *Anthistiria membranacea*, Lindl. has been found by Dr. K. Domin to comprise 4 species, of which at least 3 grow in South Australia. The bracts, which at first enclose each raceme of spikelets are here called *spathes* ("bracts" of Bentham, Fl. Aust. 7 : 543), while the larger leaf-like bracts, whose sheaths subtend several racemes, are called *involucral bracts* ("floral leaves or bracts" of Bentham).

Key to the Species.

A. Sheaths of involucral bracts herbaceous, flattened, keeled, 10-15 mm. long, the 4 involucral spikelets with 2 glumes each.
  B. Racemes more or less enclosed in the involucral sheaths; awn 20 mm. long .. .. *I. membranacea* 1
  B. Racemes quite exserted from involucral sheaths; awn 12-13 mm. long .. .. *I. actinostachys* 2
A. Sheaths of involucral bracts coriaceous, hard, convex, 7-10 mm. long; racemes closely surrounded by the sheaths; awns 17-20 mm. long, the 4 involucral spikelets with only 1 glume each .. .. *I. vaginiflora* 3

1. *I. membranacea* (Lindl.) Domin, in Bibl. Bot., Heft 95 : 280 (1915). Leaf-blades flat, 4-5 mm. broad; involucral sheaths 12-15 mm. long, flattened, keeled, herbaceous; racemes more or less exserted from the involucral sheaths; the 4 involucral spikelets about 4 mm. long, each with 2 glumes, of which the outer one is 7-9-nerved and minutely hairy or almost glabrous, all on short, stout pedicels which are much exceeded by the tufts of hair at their base; fertile spikelet 5-5½ mm. long, with a beard of long erect hairs at its base, and with a very short pedicel scarcely ½ mm. long, the outer glume 5-7-nerved, puberulent near summit, the second glume of equal length, but glabrous and 3-nerved; the third glume small, flat, hyaline; the awn (or fourth glume) about 20 mm. long; grain obovate,

2½-3 mm. long (pl. viii., fig. 2).—*Anthistiria membranacea,* Lindl. (1848), *Iseilema Mitchellii,* Anderss. (1856).

S. Australia. Peake Station, (Tate Herb.); Snake Gully, Pedirka, *E. H. Ising.*—Central and N. Australia; Queensland.

2. *I. actinostachys,* Domin, l.c. 282.—Leaf-blades flat, about 3 mm. broad; involucral sheaths 10-12 mm. long, or sometimes rather longer, flattened, keeled, herbaceous; racemes spreading-erect, conspicuous and quite exserted from the involucral sheaths; the 4 involucral spikelets 3½-4 mm. long, with 2 glumes each, the outer glume 7-9-nerved and minutely scabrous-hairy, all on short pedicels about as long or rather longer than the tufts of hair at their base; fertile spikelet 5 mm. long, bearded by a few long hairs at base and on a pedicel of about 1 mm., the outer glume 7-nerved, ciliate on margins and puberulent on lower part of back; awn or fourth glume very slender, 12-13 mm. long; grain elliptic-oblong, 2½ mm. long (pl. viii., fig. 1).—*Anthistiria membranacea,* Turner, Aust. Grasses, pl. xi. (1895).

S. Australia. Near Oodnadatta, *Miss Staer;* Abminga Creek, *J. B. Cleland;* Minnie Downs, *L. Reese.*—Queensland.

3. *I. vaginiflora,* Domin, l.c. 281. Leaf-blades flat, 3-5 mm. broad; involucral sheaths 7-10 mm. long coriaceous, hard, rounded on back and scarcely keeled, almost completely concealing the racemes and their spathes, with the exception of the awns; 4 involucral spikelets consisting of only 1 glume each 3½-4 mm. long, 5-11-nerved, glabrous except ciliation near summit, always without stamens, all on short pedicels about as long or rather shorter than the tufts of hair at their base; fertile spikelets 6 mm. long, glabrous or with a few hairs at base, on a pedicel of about 1 mm., the outer glume 7-nerved, glabrous except ciliation near margin; awn slender 17-20 mm. long; grain elliptic-oblong, about 3 mm. long (pl. viii., fig. 3).

S. Australia. Near Oodnadatta, *Miss Staer;* Swallow Creek (10 miles N. of Oodnadatta), *R. Tate;* Marree, *D. N. George;* W. of Lake Torrens and Cordillo Downs, *J. B. Cleland.*—North Australia; Queensland.

In our 3 species the outer or first glume of the fertile spikelet is always 2-toothed at summit, the second glume is of about the same length, the third is hyaline and about ½ as long; the long pedicels of the 2 small upper male or barren spikelets of each raceme are more or less hairy. The embryo occupies about ⅔ of the compressed grain; the hilum is punctiform and basal.

Domin's fourth species—*I. macrathera,* with awns 3 cm. long or more—belongs to N.E. Queensland. All are known as "Flinders Grass."

Aristida.

Much new light has been thrown on our species of *Aristida* by two recent works of Dr. J. Th. Henrard, of Leiden—"A critical revision of the genus Aristida," published in the Mededeelingen van's Rijks Herbarium (1926-28) and "A monograph of the genus *Aristida,*" in the same periodical, vol. i. (1929), vol. ii. (1932). These important publications describe the *Aristidas* of the whole world, about 320 species. It should be observed that Henrard, in his descriptions, applies the term "column or beak of the awn" to the straight, entire, usually twisted portion, which in several species forms a prolongation of the flowering glume, and reserves the term "awn" for the 3 long bristles which terminate the awn considered as a whole and which are always present in the genus, even when the supporting column is absent. For purposes of examination the flowering glume must be ripe, for in the early stages the characteristic clothing of hairs or bristles is often insufficiently developed.

The following key deals with our South Australian and one Central Australian species:—

SECTION I. *Arthratherum.* Flowering glume articulate at summit, the long, twisted column falling off at maturity; outer glumes very unequal; panicle narrow.

A. Stems rather stiff; panicle not half length of stem; flowering glume 9-10 mm. long .. .. *A. Browniana* 1
A. Stem more slender; panicle half or more as long as stem; flowering glume 6 mm. long .. .. *A. arenaria* 2

SECTION II. *Chaetaria.* Flowering glume not articulate at summit; column absent, or if present, not articulate on the glume.

B. Awns sessile on flowering glume without any intervening column or beak.
C. Margins of flowering glume convolute (one overlapping the other).
D. Panicle short (5-8 cm. long), dense, not interrupted, nearly as broad as long; outer glumes very unequal; flowering glume glabrous .. .. *A. Behriana* 3
D. Panicle long (10-20 cm.), narrow, interrupted towards base; outer glumes subequal; flowering glume bristly in upper half.
E. Panicle very narrow; awns to 18 mm. .. .. .. *A. echinata* 4
E. Panicle rather broader and looser; awns to 25 mm. .. *A. muricata* 5
C. Margins of flowering glume involute, thus forming a furrow on the ventral side.
F. Panicle narrow, interrupted, to 35 cm. long; awns unequal, 25-35 mm. long .. .. *A. biglandulosa* 6
F. Panicle oblong, dense, 3-7 cm. long; awns equal, 10-12 mm. long .. .. *A. anthoxanthoides* 7
B. Awns supported by a twisted column or beak, as in the section *Arthratherum*, but the column shorter and not articulate on the flowering glume (sub-section *Schoenatheron*). Leaves flat, often twisted; panicle narrow; column 5-6 mm. long .. *A. latifolia* 8

1. *A. Browniana,* Henr. Rev. 63 (1926). Stems erect, rather stiff, 15-40 cm. high; leaf-blades convolute-filiform, 8-20 cm. long; panicle 8-15 cm. long (with the awns), very narrow; outer glumes 1-nerved, very unequal, at first purplish, later straw-coloured, the lower 8-12 mm. long, the upper 15-22 mm. long; flowering glume 9-10 mm. long (including bearded callus of about 2 mm.), smooth except for minute tubercles near summit; column 25-38 mm. long, rarely longer, twisted; awns subequal, slender, 35-65 mm. or rarely longer (pl. viii., fig. 8).—*A. stipoides,* R. Br. (1810) non Lamk. (1791).

S. Australia. From the Flinders Range, near Lake Torrens, northwards. There is also one record from as far S. as Angaston.—Central and N. Australia; N. S. Wales; Queensland and (according to Henrard) W. Australia.

Henrard considers it probable that *A. Browniana* is a hybrid between his new tropical species *A. Muelleri* and *A. arenaria.* He distinguishes *A. Muelleri* from *A. Browniana* as having "column of awns about 4 cm. long; upper glume more than 2 cm. long." We have, however, specimens with awns to 4 cm. long and short outer glumes, and others where the reverse is the case. The length of the combined flowering glume and callus, together with the habit of the plant, appear to yield the best distinguishing characters for *A. Browniana* and *A. arenaria,* but they leave no satisfactory place for *A. Muelleri.* A specimen from the Adelaide River, N.A., preserved in the Tate Herbarium, has the lower glume 11 mm., the upper 25 mm., the column 35-38 mm. and the awns 7-8½ cm. From Cockatoo Creek, in the northern part of Central Australia, I have a specimen with the column 36-43 mm. and the awns 5½-6½ cm. Both have the long flowering glume of *A. Browniana.*

2. *A. arenaria,* Gaudich. Stems slender, densely tufted, 8-30 cm. high; leaf-blades filiform, glabrous, 3-8 cm. long, often curved; panicle 5-20 cm. long, narrow, always occupying half or more of the plant; outer glumes very unequal, 1-nerved, dark-purple, withering to straw-colour, the lower 9-12 mm. long, the upper 15-26 mm. long; flowering glume 5-6, rarely 7 mm. long (including callus of 2 mm.), glabrous except for minute tubercles towards summit; column 18-26 mm.; awns subequal, slender, 3½-7 cm. long.

All the Australian States, but usually in dry country.

Var. *hirsuta,* Henr. Leaves hairy. — Mount Lyndhurst; Lake Frome (Flinders Range).

4. *A. echinata,* Henr. Monogr. 284 (1932). Stems erect, rather stiff, 20-50 cm. high, about 1 mm. thick; leaves almost glabrous except hairs at orifice of sheath, the blades convolute-filiform, rather stiff; panicle 10-20 cm. long, narrow, spike-like, usually straw-coloured, the branches erect, rather distant towards base; outer glumes strongly 1-nerved, subequal, mucronate, scabrous on keel, about 8-9 mm. long; flowering glume 8-9 mm. long (including the bearded callus), bristly with short glassy conical hairs in its upper half, sometimes mottled with purple; awns rather broad and flat at base, about equal, 12-18 mm. long (pl. viii., fig. 7).

S. Australia. Flinders Range (Mount Parry Gap, Mount Lyndhurst, Aroona Range, Moolooloo); Cordillo Downs.—N. S. Wales; Queensland.

Var. *nitidula,* Henr. Only differs from the type in the outer glumes glabrous or almost so; the first outer glume is sometimes slightly longer than the second and may reach 10 mm. or a little more.

S. Australia. Finniss Springs (near Lake Eyre); Mount Goolwa (S. of Musgrave Ranges).—Central Australia (near Mount Thomas); N. S. Wales; Queensland; W. Australia (Victoria Desert; Fraser Range, *R. Helms).*

5. *A. muricata,* Henr., l.c. 285. Stems rigid, 50-70 cm. high, 2-2½ mm. thick; nodes glabrous, leaf-blades minutely scabrous, long, flat but convolute and acute in the upper part or almost all the way; orifice of sheath hairy; panicle 12-26 cm. long, straw-coloured, narrow and compact above, rather loose below, the branches erect and the lower ones distant; outer glumes 1-nerved, rather unequal, the lower one 8-10 mm. long, scabrous on keel, the upper 10-12 mm. long, scabrous on keel only near summit, both with a mucro usually inserted between 2 small terminal teeth; flowering glume (including the bearded callus) 9-11 mm. long, becoming purplish, more or less bristly in upper half with small glassy erect hairs; awns subequal, slender, 15-25 mm. long.

S. Australia. Swallow's Waterhole (called "Swallow Creek" by Tate), about 10 miles N. of Oodnadatta, May 5, 1894, *R. Tate;* Arkaringa Creek, *R. Helms.*

Central Australia. Horseshoe Bend, Finke River, *E. H. Ising.*—N. S. Wales.

6. **A. biglandulosa,** nov. sp. Culmi caespitosi, rigidi, saepe plus quam metrales; foliorum laminae superiores filiformes, inferiores planiusculae, vaginis orificio pilosis; panicula 20-35 cm. longa, angusta, superne compacta, purpurascens, ramis erectis, inferioribus distantibus, 8-10 cm. longis, plerisque ad basin glandulis binis instructis; glumae exteriores subaequales, mucronatae, purpurascentes, fere glabrae, 14-16 mm. longae, prima sub-3-nervi, secunda 1-nervi; gluma florifera (cum callo barbato) 11-12 mm. longa, glabra, punctulata, purpurea, marginibus involutis sulcum denticulatum efformantibus; aristae inaequales, suberectae, centralis circa 30-35 mm. longa, laterales circa 25-30 mm. longae. (pl. viii., fig. 9).

Central Australia. Glen Helen, June, 1894, *R. Tate;* Alice Springs, August, 1931, *J. B. Cleland.*

7. *A. anthoxanthoides* (Domin) Henr. Rev. 29 (1926). Stems 8-30 cm. high; leaves subulate, 3-5 cm. long, somewhat rigid, minutely scabrous; panicle oblong, dense, 3-7 cm. long, 1-1½ cm. broad; outer glumes somewhat unequal, 1-nerved, mucronate, the lower 5-6 mm., the upper 6-7 mm. long; flowering glume about 6 mm. long (including bearded callus of 1 mm.), very scabrous or almost bristly in upper half, furrowed on the ventral side by the involute margins; awns equal, 10-12 mm. long, divergent when ripe (pl. viii., fig. 5).—*A. Adscensionis* var. *anthoxanthoides,* Domin (1915); *A. depressa,* Benth. and others partly, not Retz; *A. Adscensionis* of other Australian authors partly, not of L.

S. Australia. Mount Lyndhurst; Mount Parry; Calanna Station; Andamooka Station; Musgrave Ranges; Diamentina River; Cordillo Downs.—Western N. S. Wales.

8. *A. latifolia,* Domin, in Bibl. Bot., Heft 85 : 339 (1915), nov. var. **minor.** Stems erect, rigid but rather slender, 40-50 cm. high, 1-1½ mm. thick; leaf-blades long, flat except towards the summit, 2-3 mm. broad, striate, minutely scabrous above, glabrous below, becoming twisted; orifice of sheath almost glabrous; panicle 12-15 cm. long, narrow, pale-coloured, branches erect, the lower ones rather distant; outer glumes subequal, 1-nerved, mucronate, about 10 mm. long, the lower one scabrous on keel, otherwise both glabrous; flowering glume (including the bearded callus) 5-6 mm. long, scabrous towards summit and surmounted by a slender continuous twisted scabrous column of 5-7 mm., or about 12 mm. long in all; awns subequal, very slender, 15-18 mm. long (pl. viii., fig. 6).

Var. *minor* differt a typo praecipue paniculâ aristisque valde brevioribus.

S. Australia. Near Oodnadatta, *Miss Staer;* Snake Gully, near Pedirka, *E. H. Ising.*

The type occurs in N. Australia, N. S. Wales, Queensland and W. Australia. According to Domin's description it has the panicle up to 50 cm. long and the awns 20-30 mm. long, although the drawing on plate 112 of the monograph shows the awns only 19-21 mm. long.

A. ramosa, R. Br., and *A. calycina,* R. Br. belong to Eastern N. S. Wales and Queensland. Their names have been applied to many S. Australian specimens, but apparently they are not natives of this State.

Eragrostis elongata (Willd.) Jacq. Eclog. Gram. 3, t. 3 (1813). Stems slender, erect, 20-40 cm. high; leaves glabrous, the basal sheaths broad, the orifice usually with a few silky hairs, the blades 4-20 cm. long, filiform or flattish in lower part and then 2-3 mm. broad; panicle very loose, 8-15 cm. long, the lower branches distant, sometimes shortly again branched near base, finally spreading, 2-6 cm. long; spikelets linear, greenish to lead-coloured, 6-10 mm. long, about 2 mm. broad, 8-18-flowered, 1-furrowed down the centre, on capillary pedicels ½-4 mm. long, solitary or twin, the terminal pedicel sometimes 10-15 mm. long; flowering glumes 2 mm. long, conspicuously 3-nerved; palea about ¾ as long, curved, strongly ciliate on the 2 nerves; rhachilla finally disarticulating downwards; grain globular to ovoid, ½-¾ mm. long, pale or reddish (pl. viii., fig. 10). —*E. Brownii* (Kunth) Nees (1841) partly; *Poa elongata,* Willd. (1809); *P. polymorpha,* R. Br. (1810) non Koenig (1803).

S. Australia. Bridgewater; Blumberg; Square Waterhole; Mount Compass; Onkaparinga Gorge; Inman Valley; Myponga (all in Mount Lofty Range).—Victoria; N. S. Wales; Queensland; North Australia; tropical Asia; New Caledonia.

Dr. Domin points out that *E. Brownii,* as described by Bentham in the Fl. Aust., is a mixture of *E. elongata,* Jacq., *E. diandra* (R. Br.) Steud. and *E. pubescens* (R. Br.) Steud. Forms of *E. diandra* with the spikelets few in the clusters or in short dense spikes and sometimes very shortly pedicellate, such as

we have from Sevenhills, Bordertown and Naracoorte, were placed by Bentham under *E. Brownii*. *E. pubescens* belongs to tropical Australia.

Eragrostis xerophila, Domin in Journ. Linn. Soc. 41 : 281, t. 12 (1912). Densely tufted perennial, with numerous slender but rigid stems, 25-40 cm. high, rising from hard bulbous bases arranged along the shortly woolly rhizome, which is covered by short, scarious, deltoid, striate scales, as in *E. laniflora;* leaf-sheaths tight, minutely hairy on margins near orifice; blades short, more or less spreading, striate, subdistichous, rather stiff but not pungent, 1½-5 cm. long, flat near base and 2-3 mm. broad, scaberulous above, glabrous below, often breaking off abruptly from the sheath; panicle narrow, spike-like, 5-14 cm. long, 6-10 mm. broad, the lower branches alternate, short, erect, 2-7-spiculate; spikelets linear, subsessile, 6-14 mm. long, 1-2 mm. broad, 10-30-flowered, longitudinally 1-furrowed, brownish-purple, later straw-coloured, suberect; flowering glumes 2-2½ mm. long, the lateral nerves faint; palea nearly as long, ciliolate on nerves; grain ovoid-oblong, 1-1¼ mm. long.

S. Australia. Finniss Springs, *F. D. Warren;* Snake Gully, Pedirka, *E. H. Ising;* Calanna Station, *J. P. H. Fabian;* Peake River, *Chandler.*—Central Australia; W. Australia.

Differs in minor particulars from the type: the leaf-blades are stiff and acute, but not pungent, rather broader (1-1½ mm. broad in Domin's description), the panicle sometimes slightly longer and the branches occasionally with more numerous spikelets. The type was collected by Dr. E. Clement between the Ashburton and De Gray Rivers, W.A. The species is distinguished from *E. eriopoda, laniflora* and *setifolia* chiefly by the short broad leaves and cylindrical panicle.

Mr. Warren, of Finniss Springs, writes:—"A very tough grass, growing in clay and stony places; never dies out; stock eat it readily."

Eragrostis Kennedyae F. Turner. Specimens collected by E. H. Ising at Wall Creek, C.A., just beyond our border, have the panicle 5-12 cm. long, purplish and looser than usual, so that, when fully out, it is 10-15 mm. broad at the base. The upper branches are more erect than in *E. japonica,* the panicle of which has a much looser appearance, not only on account of the spreading-erect branches, but because the lateral pedicels of the spikelets are 1-1½ mm. long, while in *E. Kennedyae* and *E. confertiflora* they are only ¼-½ mm. long.

Eriachne Isingiana, nov. sp. Gramen annuum, 10-15 cm. altum, culmis supra basin ramosis, geniculatis, gracilibus, ad basin et divisionem ramorum foliatis; folia pilis e tuberculis ortis instructa, vaginis laxis, striatis, brevibus, laminis lineari-lanceolatis, planis, 10-25 mm. longis, circa 2 mm. latis; folium supremum fere ad vaginam 15-20 mm. longam, glabrescentem, basin rhacheos florentis arcte amplexantem redactum; panicula valde exserta, angusta, spiciformis, 12-25 mm. longa, 5-6 mm. lata; spiculae 4 mm. longae, biflorae, pedicellatae; glumae exteriores glabrae, purpurascentes, circa 3½ mm. longae, acutae, 7-nerves; gluma florifera 3½-4 mm. longa, acuminata sed non aristata, dorso inferne villosa, superne glabra et 5-nervi; palea paulo brevior, dorso villosa, apice biaristulata; semen obovatum, rubellum, 1½ mm. longum (pl. ix., fig. 6).

Pedirka, September, 1932. Part of the valuable collection made in the Far North by Mr. E. H. Ising, to whom the species is dedicated. Near *E. pulchella* Domin, of Western Australia, differing in the more leafy stems, longer spikelets and glumes, and in the palea tapering to a fine point which is not entire, but consists of 2 small erect parallel awns. Both species agree in the uppermost leaf of each stem being almost reduced to a long sheath which embraces the base of the panicle-axis and is surmounted by a very short inconspicuous blade.

Dactyloctenium radulans (R. Br.) Beauv. Agrost. 72 (1812) instead of *D. aegyptium* (L.) Richt. Appears to be specifically distinguished from the Asiatic and African plant by its shorter and more numerous spikes (6-12 mm. long and usually 4-10 in number, instead of 12-25 mm. long or more and 2-5 in number, as in *D. aegyptium)* and by the glumes with ciliolate keels, not glabrous. —*Eleusine radulans,* R. Br. Prodr. 186 (1810).

S. Australia. All our northern districts.—North and Central Australia; Queensland; N. S. Wales; N.E. Victoria. Said also to occur in Abyssinia, Sokotra and S.E. Arabia.

Our plant, popularly known as Button Grass, provides good feed, which is said not to be the case with *D. aegyptium.* The spikes of *D. radulans* sometimes spread horizontally when in fruit.

Stipa nitida, Summerh. et Hubbard. This shining grass is common at Mount Ferguson, near Port Pirie, which is its most southerly locality near the Flinders Range and the only maritime station yet discovered. The outer glumes may be only 8-9 mm. long.

Stipa acrociliata, Reader, Ardrossan, November, 1932, *E. C. Black.* A new locality for this handsome grass. These specimens from Yorke Peninsula have a ring of short white appressed hairs below each glabrous node of the stem.

**Schismus barbatus* (L.) Juel. This small Mediterranean and South African grass, which was first collected along the Broken Hill railway, has now appeared in our Murray lands and Far North. It has also extended to New South Wales and Victoria, and is said by some observers to be good fodder.

**Psilurus aristatus* (L.) Duval-Jouve (1866). In scrub near Saddleworth, *Worsley C. Johnston;* cliffs S. of Hallett's Cove, *J. B. Cleland.* A very slender annual Mediterranean grass, not previously recorded.—*Nardus aristata,* L. (1763); *Psilurus nardoides,* Trin. (1820).

Astrebla lappacea (Lindl.) Domin in Bibl. Bot. 85 : 372 (1915). This name must replace that of *A. triticoides* (Lindl.) F. v. M. As shown by C. E. Hubbard in Kew Bull., 1928, *Danthonia lappacea,* Lindl. (1839) and *D. triticoides,* Lindl. (1848) are conspecific. Bentham considered, mistakenly, that *D. lappacea* was the form of Mitchell Grass with hooked awns, which he named *A. triticoides* var. *lappacea.* This has now been described as *A. squarrosa,* Hubbard. It has not so far been found in South Australia.

Elytrophorus spicatus (Willd.) A. Camus in Lecomte, Fl. gén. Indo-Chine 7 : 547 (1923). Abminga Creek, August 2, 1931; *E. H. Ising.* This small plant, which looks more like a *Juncus* than a grass, has not been recorded in South Australia for some 80 years. In the Fl. Aust. it is noted for "Murray River, S.A., *F. Mueller;* Charlotte Waters, *C. A. Giles.*" It has recently been found in the Wimmera, Vict. The flowering glume in our specimens is 4-5 mm. long, including the narrow point, which can scarcely be described as an awn, as it is open almost to the summit. It has 3 nerves, but the 2 lateral ones ascend only as far as the base of the point and are not excurrent. The broad dorsal (abaxial) denticulate wings of the palea embrace the base of the adjoining flower in the spikelet, while the 2 inner (abaxial) wings are very narrow and embrace the grain in the usual manner. The grain is 1 mm. long, ovoid-oblong, slightly compressed, brown, the embryo acute and extending $\frac{1}{4}$ of its length, the hilum basal and punctiform. The outer glumes are 1-nerved and distinctly shorter than the 3-5 flowers of the spikelet (pl. viii., fig. 4).

The chief synonyms are: *Dactylis spicata,* Willd. in Ges. Naturf. Fr. N. Schr. 3 : 416 (1801); *Elytrophorus articulatus,* Beauv. Agrost. 67 (1812). Hitherto the latter specific name has been generally used, but has to give place to Willdenow's under the law of priority. This grass is a native of Southern Asia as well as of Australia.

Cyperaceae.

Cyperus aristatus, Rottb. Descr. et icon. 23, t. 6, fig. 1 (1773) instead of *C. squarrosus,* L. p.p. Linnaeus confused 2 species in his descriptions of *C. squarrosus. C. aristatus,* which occurs in Australia, India, tropical Africa and America, has the glumes conspicuously 5-7-nerved, with 2-3 nerves on each side, besides the keel-nerve, and the rhachilla is persistent, so that the plant belongs to the section *Eucyperus. C. squarrosus* is a native of India, Cochin-China and Africa. Its glumes are 3-5-nerved on the keel only, and the rhachilla disarticulates at its base and falls off when ripe. It belongs to the section *Mariscus. C. aristatus* has been found at Alberga Creek, Macumba River, Minnie Downs and other places in the Far North; also in Central Australia, North Australia and Queensland.

Liliaceae.

Bulbine semibarbata (R. Br.) Haw. A curious form was collected at Callana, 9 miles north of Marree, by Professor Cleland. Only 4-8 cm. high, it has all the filaments bearded at some distance under the anther and not close below it, as in *B. bulbosa.* Moreover it has the fibrous roots, the ovules, the trigonous and wrinkled seeds and the smaller flowers of the typical *semibarbata. B. semibarbata* has only 2 ovules in each cell of the ovary, or 6 in all, while *B. bulbosa* has about 4 ovules in each cell or about 12 in all. Both species have the upper part of the perianth-segments slightly twisted in a deciduous calyptra which covers the young capsule.

Iridaceae.

**Gladiolus cuspidatus,* Jacq. This South African plant, originally an escape from gardens, has been found growing, usually near creeks, at Mount Lofty, Morialta Gully, Nairne, Normanville, and Kersbrook; also Koppio, E.P. In some of these places it is abundant, and should, therefore, be considered an established alien. It is also common in parts of Victoria.

**Moraea xerospatha,* MacOwan var. *monophylla,* J. M. Black, was collected by Pastor Hoff at Koonibba Mission Station, near the Great Bight, in September, 1928.

Santalaceae.

Santalum lanceolatum, R. Br. Granite hills 24 miles east of Oparinna, at the western end of the Musgrave Ranges; *H. H. Finlayson,* December, 1932. This appears to be the first time that the typical form, with ovate or oblong, acute, thick and rigid leaves, 2-3 cm. broad, has been found in South Australia. The locality is near the border of Central Australia. The plant is a shrub or small tree 4-6 m. high and is fairly numerous. By the white inhabitants it is called "Plum Bush," on account of the juicy dark-blue fruit, which is eaten by the natives. The wood is aromatic. Our ordinary form is the narrow-leaved var. *angustifolium,* Benth.

Chenopodiaceae.

Bassia articulata, nov. sp. Fruticulus glaber absque lanâ densâ in axillis foliorum; folia 3-10 mm. longa, 1 mm. diam., plano-convexa, subclavata; perianthia fructifera in ramulis brevibus ad basin attenuatis articulatisque dense aggregata, quasi imbricata, tubo lineari-oblongo, 4-5 mm. longo, areolâ longâ obliquissimâ quasi laterali ad ramulum affixo, limbo scarioso, erecto, ciliato, 1½ mm. longo, spinis 3, gracilibus, patentibus vel recurvis, 5-8 mm. longis, saepe rubris; semen verticale (pl. ix., fig. 2).

Pedirka railway station (Far North), August, 1932, *J. B. Cleland.*

Differs from *B. intricata* in the spines always 3; the perianths are crowded, as in that species, on short branches, but these branches are narrowed, almost

pointed, articulate at base and finally separate without tearing; from *B. divaricata* it differs in the fewer and shorter spines, often recurved, and in the erect limb of the perianth; from *B. tricuspis* in the perianth-tube linear-oblong, not swollen at base and more obliquely adnate to the branch; from both it differs in the articulate branchlets.

Nyctaginaceae.

Boerhavia diffusa, L. Specimens with almost glabrous leaves and others with the whole plant glandular-viscid occur in the Musgrave Ranges. Concerning the latter form Mr. Allan Brumby, of Ernabella, informed Mr. H. H. Finlayson that the plant often becomes a dense sticky mass lying prostrate on the ground, and that small insectivorous birds are trapped in it. The native children then collect and cook the birds.

Aizoaceae.

Carpobrotus aequilaterus (Haw.) N. E. Br. in Journ. Bot. 66 : 324 (1928), instead of *C. aequilateralis*, J. M. Black in Trans. Roy. Soc. S. Aust. 56 : 41 (1932). The form of the specific name is due to the fact that the species was first published by Haworth (in 1794) as *Mesembryanthemum aequilaterum*, and only later (in 1803) as *M. aequilaterale*. Mr. N. E. Brown remarks:—"In modern books all Australian members of this genus *(Carpobrotus)* are referred to *M. aequilaterale*, Haw., but from the very scanty material at Kew, I believe that when properly examined and when the character of the ripe fruit (which has never been noted) is taken into consideration, at least 4 or 5 well-marked species will be found to exist there. None of the material I have seen belongs to the true *C. aequilaterus*, which has slender stems and the smallest leaves of all known species. I have never seen it, but from an original drawing of the type at Kew, it is evident that Salm Dyck's figure correctly represents this species. It is unknown in which part of Australia it grows."

**Cryophytum nodiflorum* (L.) L. Bolus, instead of the names *C. caducum* (Ait.) L. Bolus, used in these Trans. 56 : 41 (1932) and *Mesembryanthemum caducum*, Ait., used in Fl. S. A., 219 (1924). *M. caducum* appears to have been misunderstood by earlier botanists, and this correction has been kindly made by Mr. N. E. Brown on specimens collected near Port Germein.

Papaveraceae.

In view of the question sometimes raised as to the identity of the South African *Papaver aculeatum*, Thunb. and the *P. horridum*, DC. (described from Australian specimens), Sir Arthur Hill, Director of the Royal Botanic Gardens, Kew, was good enough to have the material in the Kew Herbarium examined by Messrs. V. S. Summerhayes and R. A. Dyer. They consider that the specimens passing under these two names are conspecific, stating that "there do not seem to be any recognisable differences between them." The earlier name, *P. aculeatum*, will therefore continue as that of our Australian plant, which, at least in South Australia, seems to be rapidly approaching extinction. As the references were wrongly given by Bentham, Fl. Aust. 1 : 63, they are here quoted as supplied by Messrs. Summerhayes and Dyer:—*Papaver aculeatum*, Thunb. Prodr. Fl. Cap. 2 : 92 (1800); Fl. Cap. ed. Schultes 431 (1823). *P. horridum*, DC, Syst. Veg. 2 : 79 (1821). *P. gariepinum*, Burchell ex DC. Syst. Veg. 2 : 79 (1821).

**Papaver somniferum*, L. var. *setigerum* (DC.) Boiss. This Mediterranean variety, distinguished by its bristly peduncles and smaller capsules with usually only 7-8 stigmatic rays, has been found near Mile End, *J. Crocker*, and near Roseworthy Agricultural College, *G. H. Clarke*.

Cruciferae.

**Neslia paniculata* (L.) Desv. This European and West-Asiatic weed has established itself of recent years at Roseworthy, Wasleys, Reeves Plains and Gawler River. It is distinguished by its small globular 1-celled and 1-seeded pods and by its oblong auricled and stem-clasping leaves.

Leguminosae.

**Trigonella monspeliaca*, L. Outer Harbour, October, 1932, coll. J. B. Cleland; Barabba (6 miles west of Hamley Bridge), per Department of Agriculture. This Mediterranean species has not hitherto been recorded. It is easily recognised by its clusters of 5-10 sessile slender curved pods, about 10 mm. long, nerved transversely and spreading radiately from the stem.

Swainsona tephrotricha, F. v. M. Specimens collected at Terowie by Dr. E. C. Black, in September, 1932, show that the number of leaflets varies from 7 to 21 and the number of flowers in the raceme from 15 to 28. The plants were growing in the corner of a cultivated field, where they were safe from the plough. This is much the same class of country as that in which Mueller collected the type about 1850 (from near Spalding to the Burra Mines). The true *S. tephrotricha* can at once be recognised by its ashy-white obovate-oblong leaflets 4-12 mm. long, 2-4 mm. broad, the terminal one no longer than its neighbours, all concave above and sometimes folded, rather obtuse, but with a small recurved mucro. The style has a minute tuft of hairs behind the stigma.

Swainsona uniflora, nov. sp. Planta pumila, probabiliter annua, 5-6 cm. alta, pilis densis adpressis centrifixis omnino (absque petalis) cinerea, caule 10-15 mm. longo; foliola 3-7, prope basin plantae interdum solitaria, plana vel supra concava, ovato-lanceolata, recurvo-mucronata, 8-15 mm. longa, 3-6 mm. lata, terminale longius quam lateralia; stipulis lineari-lanceolatis; pedunculus uniflorus, 2-3 cm. longus, folium subaequans vel paulo brevior; pedicellus bracteatus, calyce brevior; calyx 7 mm. longus, dentibus lanceolatis paulo longioribus quam tubus; bracteae bracteolaeque minutae; flores purpurascentes, siccitate flavescentes; vexillum 11 mm. longum, 12 mm. latum, callis duobus confluentibus decurrentibusque praeditus; carina obtusa, 10 mm. longa, bisacculata, vexillo brevior, alis longior; stylus tenuis, supra curvaturam rectus, fere totâ longitudine barbatus, pilis basin versus longioribus; legumen non visum (pl. ix., fig. 4).

Horseshoe Bend, Finke River, C.A., *E. H. Ising*, August, 1931. Apparently a small annual; differs from all other species in its 1-flowered peduncles scarcely exceeding the leaves. In the style and the 2 calli on the standard it approaches *S. phacoides.*

Swainsona adenophylla has been found by Prof. Cleland between Wirrulla and Yardea, a locality much further west than any previously recorded.

Acacia salicina, Lindl. In our northern districts this is often only a shrub 2-3 m. high, and when growing on the bank and not close to the creek or other water, the branches sometimes scarcely droop. It is always distinguishable from *A. ligulata* by its loose racemes or panicles, its thick straight-edged pod and its partiality for moist situations.

Acacia spinescens, Benth. Specimens have been found on the roads near Roseworthy Agricultural College with the flowerheads not sessile, but on peduncles 3-6 mm. long.

Acacia obliqua, A. Cunn. Mr. G. H. Clarke, botanist at the Roseworthy Agricultural College, has also discovered, near that institution, a form of this species with pubescent phyllodes. Some specimens from the same locality show the transition between this hairy form and the typical one with glabrous phyllodes.

Acacia mollissima, Willd., instead of *A. decurrens* (Wendl.) Willd. var. *mollis,* Lindl. This handsome wattle, found only in our South-Eastern district, deserves specific rank, as it differs from the typical *A. decurrens,* in shorter pubescent leaflets, larger flowerheads and a narrower pod, as well as in the time of flowering. *A. decurrens,* which is confined to New South Wales, although often grown here and in Victoria as an ornamental tree, flowers usually from July to September, while *A. mollissima,* which inhabits the Eastern States and Tasmania, as well as our South-East, has its ordinary flowering season in November and December.

Pultenaea scabra, R. Br. This species, hitherto only known in South Australia by one specimen, in leaf only, from Birchman Lagoon, K.I., has been found fruiting near Rocky River, K.I., by Prof. Cleland. Calyx very shortly pedunculate, about 4 mm. long, the lobes lanceolate, the 2 upper ones united to middle; pod obovate, pubescent, nearly twice as long as calyx, usually drooping.

**Trifolium arvense,* L. var. *glabrum,* Vis. has been found growing on a farm near Kapunda since 1931, but does not appear to make much progress. This form of Hare's-foot Clover is quite glabrous, even on the calyx-teeth. It has been placed by some botanists under var. *gracile* (Thuill.) Ser., which is somewhat glabrous, has the calyx-teeth merely ciliate, not plumose, and inhabits France, Italy and Spain. Var. *glabrum* belongs to the Balkan Peninsula and probably to other countries of the eastern Mediterranean.

Lotus australis, Andr. var. nov. **exstipulatus.** Variat foliis 3-foliolatis sessilibus (foliolis basilaribus stipularibus deficientibus); bracteis 1-foliolatis.

Horseshoe Bend, Finke River, C.A., *E. H. Ising.* Agrees with ordinary specimens except in the omission of the 2 lower stipular leaflets; it has a single leaflet at the base of each umbel.

Indigofera enneaphylla, L. This species, hitherto only known (in our State) from Cordillo Downs, has been found by E. H. Ising at Pedirka railway station, near the Hamilton River, Far North.

Templetonia egena (F. v. M.) Benth. Sandhills near Pedirka on the Hamilton River, a station much further north than any previous record. Coll. E. H. Ising.

**Medicago reticulata,* Benth. (*M. hispida,* Gaertn, var. *inermis,* Urb.) has appeared on the slopes of the Torrens, near Kintore Avenue.

Oxalidaceae.

**Oxalis compressa,* Thunb. Has appeared for some years in a field at Roseworthy Agricultural College. Near *O. cernua* ("Soursob"), from which it differs in the woolly calyx, the leaflets woolly on the lower face, and the broad, flattish, ciliate petioles.—S. Africa.

Rosaceae.

**Poterium Sanguisorba,* L. "Sheep's Burnet." Hill between Beaumont and Waterfall Gully, November, 1931. This is the form most common in Mediterranean countries, the fruits with 4 narrow sinuate wings and rather deeply pitted, sometimes distinguished as *P. muricatum,* Spach.

Euphorbiaceae.

Euphorbia Stevenii, F. M. Bailey in Qld. Agric. Journ., 1910, p. 288, t. 30, in place of *E. Murrayana,* J. M. Black in Trans. Roy. Soc. S. Aust., 56 : 42, t. 1, fig. 5 (1932). Bailey's type came from the claypans of the Georgina River, in the dry districts of Western Queensland. On meeting with his description and figure, published 23 years ago, I sent a South Australian specimen of *E. Murrayana* to Mr. C. T. White, Government Botanist of Queensland, who, after comparison

with the type of *E. Stevenii,* agreed with me that they are conspecific. *E. Murrayana* is, therefore, reduced to a synonym.

**Euphorbia Cyparissias,* L., a Spurge with a creeping rootstock and a native of most countries of continental Europe, has appeared along roadsides in Sefton Park.

MALVACEAE.

Hibiscus crassicalyx, nov. sp. Fruticulus omnino stellato-tomentosus; folia patentia, ovata vel ovato-oblonga, late crenulata, crassa, velutina, 3-7 cm. longa, 2-3 cm. lata; stipulae lineares, caducae; petioli crassi, circa 2 cm. longi; flores solitarii, axillares, in pedunculis crassis petiolos subaequantibus vel superantibus sub flore incrassatis et articulatis; involucrum velutinum, 2-2½ cm. longum, lobis 5 lanceolatis, tubum late cyathiformem subaequantibus; calyx involucro paulo longior, lobis lanceolato-acuminatis extus stellato-velutinis, intus pilis simplicibus instructis; petala minuta (circa 3 mm. longa), orbicularia, imbricata, alba, base purpurea, exteriora dorso stellato-tomentosa, omnia deorsum in cyathum inversum scariosum ipsis petalis aequilongum et parti inferiore columnae staminalis adnatum productae (an forma cleistogama hiemalis?) ; capsula ovoidea, circa 12 mm. longa, pilosa, 5-locularis; semina 20-25, dense lanata, 4 mm. longa (pl. ix., fig. 5).

Mount Liebig, C. Aust., August, 1932, *J. B. Cleland.*

Differs from *H. Sturtii* in the much greater length of the calyx and involucre (2½--3 cm. long), a corresponding increase in thickness, and in the fewer lobes of the involucre; from *H. Farragei* in the same particulars, also in the pointed, not clavate, lobes of the involucre and in the free style-branches. The minute petals here described are probably those of a winter-flowering cleistogamous form of the species, such as has been also observed in *H. Sturtii.*

FRANKENIACEAE.

Frankenia granulata, n. sp. Fruticulus 30-45 cm. altus; ramuli folia et calyces granulis albo-cinereis dense obtecti; folia pseudo-verticillatim congregata, teretia, rigida, 6-10 mm. longa, 1½ mm. diam., breviter petiolatis marginibus revolutis nervum medianum omnino occludentibus; internodia 5-14 mm. longa; flores in cymas corymbosas foliatas dispositi; calyx oblongo-ovoideus, 7 mm. longus; petala 5, rosea, 10 mm. longa, laminis circa 4 mm. latis; stamina 6; antherae roseae, 1½ mm. longae; styli rami 3, 2 mm. longi (cum stigmatibus clavatis) ; ovarii placentae 3, parietales; ovula 7-9 pro placentâ; capsula 4 mm. longa; semina 10-14, oblongo-ovoidea, 1 mm. longa, minute tuberculata (pl. ix., fig. 3).

Witchellina, in the Willouran Hills, S.W. of Marree, *H. H. Finlayson,* February, 1933.

Near *F. foliosa,* of which it has the habit, but is a stouter and taller plant, distinguished by its ashy-white, densely granular clothing, its longer, terete, shortly petiolate leaves, with margins so revolute as to hide the lower surface entirely, the larger calyx and petals and the fewer ovules and seeds. It is a handsome Frankenia, the white, tuberculate leaves contrasting well with the comparatively large pink flowers.

OENOTHERACEAE.

The following changes must be made in the names of our 2 introduced *Oenotheras* from temperate South America. The new and more correct determinations are due to the courtesy of Professor P. A. Munz, of Pomona College, Claremont, California, who is preparing a monograph of the genus and to whom specimens from South Australia were submitted.

**Oenothera stricta,* Ledeb., instead of *Oe. odorata,* Jacq. The 2 species are closely allied, but *Oe. odorata* has larger flowers, is glaucous, more villous and has the leaves more strongly crisped-undulate.

**Oe. affinis*, *Cambess.*, instead of *Oe. longiflora*, Jacq. Both these species of Evening Primrose have a very long beak to the receptacle, but *Oe. longiflora* has oblong, rather obtuse leaves more or less rounded at base and is covered with a much coarser pubescence, whereas *Oe. affinis* has lanceolate acute leaves narrowed at base and is covered with a soft velvety pubescence.

MYRTACEAE.

Eucalyptus diversifolia, Bonpl. Wilpena Pound, November, 1928, *J. B. Cleland*. This is the most northerly record of the species.

Eucalyptus viminalis, Labill. Wilpena Pound, November, 1930, *J. B. Cleland*. First record for the Flinders Range.

Eucalyptus incrassata, Labill. var. *protrusa*, J. M. Black. Between Whyalla and Iron Knob, E.P., *A. Morris*. The fruits in these specimens are comparatively small—5-6 mm. long, a trifle broader and slightly contracted at summit.

UMBELLIFERAE.

Hydrocotyle tripartita, R. Br. Rocky River, K.I., *J. B. Cleland*.

GENTIANACEAE.

**Microcala quadrangularis*, Griseb. This little yellow-flowered South American annual, only 2-4 cm. high, with quadrangular calyx and opposite ovate-oblong leaves, is now well established along the foothills near Adelaide. First discovered on a road near Knightsbridge in 1912, it was supposed to have disappeared, but this impression was probably due to the fact that the plant is only apparent during its few weeks of flowering in September and October.

BORRAGINACEAE.

Heliotropium tenuifolium, R. Br. nov. var. **parviflorum.** Variat corollâ calycem tantum aequante vel eo paulo breviore, intus glabrâ vel fere glabrâ.

Mount Liebig, C.A., August 16, 1932, *J. B. Cleland*. This appears to differ from the type only in the shorter corolla and its complete or almost complete lack of pubescence inside the tube. The glabrous interior of the corolla is one of the characters of the section *Euheliotropium*, but it may occur exceptionally in the section *Orthostachys*, to which *H. tenuifolium* belongs. De Candolle, in defining *Orthostachys*, says:—"Corollae tubus sub fauce vel fauce pubescens, rarissime glaber." The cohering anthers, which occur in the variety and the type, indicate *Orthostachys*. The calyx is the same in the variety and the type (3½-4 mm. long), but the corolla of var. *parviflorum* is only 2-4 mm. long, while in the typical form it is about 7 mm. long and conspicuous above the calyx. The typical *H. tenuifolium* was also collected in the same locality by Professor Cleland.

SOLANACEAE.

Nicotiana Gossei, Domin in Bibl. Bot., Heft 89 : 1,146 (1929). Plant 30-50 cm. high, green but woolly all over with short silky spreading hairs; stems 6-9 mm. thick below the inflorescence; stem-leaves undulate, sessile, clasping the stem with rounded auricles, the upper ones ovate-lanceolate, acute, 4-14 cm. long, 2-9 cm. broad near base, the lower ones tapering towards the clasping base and sometimes broadly ovate and 20 cm. long by 12 cm. broad; bracts lanceolate; flowers in racemes which are sometimes corymbose, on thick woolly pedicels 5-10 mm. long; calyx green, woolly-pubescent, 5-ribbed, 17-24 mm. long, about 6 mm. diam., the lobes lanceolate, about as long as tube; corolla woolly outside, 30-40 mm. long in all, the tube oblong, purplish, 22-30 mm. long, about 4 mm. diam. and from ⅓ longer to almost twice as long as calyx, the limb about 25 mm.

across, white, its lobes rounded; 4 anthers on filaments of 1-2 mm., the fifth lower down on a filament 6-7 mm. long, affixed 8-12 mm. above base of tube; capsule oblong-conical, smooth, brown, reticulate, 12-15 mm. long, exceeding the calyx-tube, opening in 4 valves; seeds wrinkled, 1 mm. long.

Near Ernabella in the Musgrave Ranges, *J. B. Cleland*, August, 1933. Leaves chewed by the natives as a narcotic.

The type was collected by W. C. Gosse, "in the centre of S. Australia," on his journey of 1873, when he traversed what is now the southern part of Central Australia returning through the Musgrave Ranges. His collection of plants was sent to Baron von Mueller, but his type of *N. Gossei* is at present in Leningrad, on loan from the National Herbarium of Victoria. However, our plant accords well with Domin's description. The species is chiefly distinguished by its soft, woolly, broad, sessile, stem-clasping leaves.

Nicotiana ingulba, nov. sp. Caules erecti, glabri, 30-50 cm. alti, graciles sed rigidi, circa 2 mm. diam.; folia omnia in petiolum angustata, caulina lanceolata, distantia, glabra, undulata, 4-9 cm. longa (petiolo incluso) 1-2 cm. lata, suprema linearia, radicalia, late lanceolata vel ovata, plerumque 6-11 cm. longa, 3-5 cm. lata, omnino vel fere glabra; bracteae parvae, caducae; flores racemoso-paniculati, pedicellis gracilibus, 5-10 mm. longis, puberulis; calyx 12-17 mm. longus, 5-costatus, puberulus, lobis lineari-lanceolatis, tubo quasi aequilongis; corolla saepius 4-5 cm. longa, tubo gracili, virescente, puberulo, 3-4 cm. longo, 2½ mm. diam., limbo albo, transverse 25 mm lato, lobis obtusis; 4 de antheris in filamentis circa 4 mm. longis innixi, quintum inferius in filamento circa 5 mm. longo et 20 mm. supra basin tubi affixo; capsula oblonga, 10-13 mm. longa, 4-fida, tubum calycis paulo vel multo superans, basin versus transverse rugosa; semina reniformia, rubella, rugulosa, 1 mm. longa (pl. ix., fig. 1).

Central Australia. Harper's Spring, *E. Kramer.*

Distinguished from other species by the leaves all petiolate, and from *N. Gossei* and *suaveolens* by its almost glabrous character. *Ingulba (ingoolba)* is the name applied by the natives to this and other species whose leaves they chew as a narcotic. During winter-flowering the corolla-tube may be only 2-3 cm. long.

Nicotiana excelsior. Specimens from Ernabella, Musgrave Ranges, collected by Prof. J. B. Cleland, authorise the following additions to previous descriptions:— Stems about 15 mm. diam. near base; stem-leaves rather fleshy, sessile, green, glabrous, ovate-lanceolate, acute, 10-30 cm. long, 2-10 cm. broad, including the decurrent tapering wings, which are 2-12 cm. long; calyx 20-30 mm. long, 10-ribbed, with scattered glands, the lobes rather shorter than tube, lanceolate, channelled inside and glandular-denticulate along the margins; corolla-tube 35-50 mm. long, purplish, minutely pubescent, the limb white, 30-35 mm. across, the lobes very shallow and obtuse; 4 anthers on filaments about 1 mm. long, the fifth lower down, on a filament 10-15 mm. long, affixed 20-30 mm. above base of tube. Flowering specimens are sometimes less than 1 m. high. Mr. H. H. Finlayson also collected specimens at Walthaljalkana, in the northern Everards, where the plant is called "mingle" by the natives. The slightly perfumed flowers open before sunset.

N. macrocalyx, Domin in Bibl. Bot., Heft 89 : 1,147 (1929) is a synonym of *N. excelsior,* which was published by me in 1926. The type of *N. macrocalyx* was collected by R. Helms in the Birksgate Range, S.A., in 1891, and a co-type, which agrees exactly with *N. excelsior,* is in the Tate Herbarium.

SCROPHULARIACEAE.

Peplidium maritimum (L. f.) Wettst. (1891). This species, distinguished from P. Muelleri chiefly by its sessile or subsessile flowers and fruits, was recorded by Tate for Central Australia, but had not been found in our State until

it was collected near the Abminga Creek, August 6, 1932, by Prof. J. B. Cleland. It also inhabits North Australia, Queensland, northern New South Wales, Egypt, and India. Synonyms:—*Hedyotis maritima*, L. f. Suppl. 119 (1781); *Peplidium humifusum*, Delile, Fl. aegypt. illustr. 148 (1813).

Myoporaceae.

Eremophila Battii F. v. M. n. var. **major.** Variat foliis floribusque majoribus quam in typo. Folia usque 2 cm. longa; calyx circa 12 mm. longus; corolla 30 mm. longa.

Finke River, C.A., August, 1931; coll. J. B. Cleland.

Eremophila Willsii, F. v. M. var *integrifolia*, Ewart, Fl. N. Terr. 254 (1917). On granite hills at Ernabella, Musgrave Ranges, January, 1933, *H. H. Finlayson.* "Straggling shrub 60 cm.-1m. high; flowers pale-blue." All the leaves on the 2 specimens are entire; the sepals are about 10 mm. long the corolla under 20 mm. and the peduncles 3-4 mm. long.

Rubiaceae.

Messrs. H. K. A. Shaw and W. B. Turrill revised the Australian *Asperulas* in the Kew Bulletin of 1928, replacing *Galium geminifolium*, F. v. M. by a new name:—

Asperula gemella, Shaw et Turrill. Flaccid plant; leaves in pairs, linear, 5-30 mm. long, glabrous, the margins more or less recurved, the interpetiolar stipules usually minute or absent, rarely leaflike; flowers in irregular cymes; male corolla about 1½ mm. long, the lobes more than 3 times as long as the tube; female corolla about 1¼ mm. long, the lobes 4 times as long as the minute tube, and spreading, so that the corolla appears rotate; fruit rugose, 2-3 mm. diam.

In swamps and floodwaters near rivers in South Australia, Victoria, New South Wales and S.W. Queensland. It was originally described as *Galium geminifolium* by Mueller in Trans. Vict. Inst., 1 : 147 (1855), and by Bentham, Fl. Aust. 3 : 445 (1866), and was illustrated (as *Asperula geminifolia)* in Key Vict. Pl. t. 75 and Pl. Vict. t. 31. The true *Asperula geminifolia*, F. v. M. Fragm. 5 : 147 (1866); Benth. Fl. Aust. 3 : 443 (1866), with the tube rather longer than the corolla-lobes, is, as far as is known, confined to the eastern coast of Queensland.

Shaw and Turrill distinguish their new species *A. euryphylla* from *A. Gunnii*, Hook. f. chiefly by the fact that the leaves of *euryphylla* dry green, while those of *Gunnii* dry black. They therefore transfer our Kangaroo Island plant from *A. Gunnii* to *A. euryphylla* var *tetraphylla*, Shaw et Turrill. Our specimens have the small ovate or elliptical leaves usually in 4's, rarely in 3's or 5's, glabrous except for short cilia on the margins and along the midrib below.

Campanulaceae.

Isotoma petraea, F. v. M. Walthajalkana Soak, Everard Range; Ernabella Waterhole, Musgrave Ranges. Found round soaks and more widely spread on the sandhills. Mr. H. H. Finlayson reports that this plant is often fatal to camels which eat it.

Goodeniaceae.

Goodenia unilobata, J. M. Black. This species, hitherto only known by a scrap in the Tate Herbarium, labelled "Ooldea," without date or name of collector, has been found by Prof. J. B. Cleland at Rumbalara, S. of Horseshoe Bend, River Finke, C.A. Some particulars can, therefore, be added to the description in Trans. Roy. Soc. S. Aust., 51 : 383 (1927) and in Fl. S.A., 554. Stems several, prostrate or ascending, 10-15 cm. long, pubescent in all their length or glabrous near base; leaves usually irregularly, broadly and obtusely lobed towards the base

(the stem-leaves often conspicuously 1-lobed), minutely and distantly toothed in upper part, rarely entire, the radical ones 3-4 cm. long, about 10 mm. broad, tapering into a petiole 12-15 mm. long, all the leaves nearly glabrous except for short cilia along the margin; peduncles always 1-flowered and rising from the axils of the radical, as well as from those of the stem-leaves.

Near *G. heterophylla*, Sm., of Eastern Australia, but differs in the stem-leaves often prominently 1-lobed, the long petioles of the radical leaves, the larger corolla, the longer dissepiment and the arid habitat. The capsule and seeds have not been seen.

Compositae.

**Iva axillaris*, Pursh. This scabrous perennial, about 30 cm. high, has established itself in a vineyard near Sevenhills for about 8 years past. It belongs to the tribe *Heliantheae*, subtribe *Ambrosiinae*, and has racemes of small pedunculate drooping heads, one in each of the upper axils. A native of North America, from the Saskatchewan to New Mexico and California. This appears to be its first record in Australia. I received an excellent specimen through Mr. Worsley C. Johnston.

**Centaurea nigra*, L. Knapweed. Encounter Bay, September, 1928, *J. B. Cleland.* First record for South Australia; recorded for Victoria in 1925.—Europe.

Pterocaulon sphacelatum (Labill.) Benth. et Hook. Witchellina, S.W. of Marree. H. H. Finlayson reports that this plant is known as "Apple Bush" on account of its pleasant odour of apple.

Dimorphocoma minutula, F. v. M. et Tate has been found by Prof. Cleland at Curdiemurka, N. of Marree. It has hitherto only been collected in the Flinders Range near Lake Torrens.

Minuria integerrima (DC.) Benth. and *M. denticulata* (DC.) Benth. have frequently, in at least some of the heads, female ligulate flowers only, the bisexual disk-flowers being absent.

DESCRIPTION OF PLATES.

Plate VIII.

Fig. 1. *Iseilema actinostachys:*—*A,* raceme of spikelets; *B,* grain.

Fig. 2. *Iseilema membranacea:*—*C,* raceme of spikelets; *D,* grain.

Fig. 3. *Iseilema vaginiflora:*—*E,* involucral bracts enclosing spathes and racemes; *F,* raceme of spikelets; *G,* solitary glume of involucral spikelets; *H,* grain.

Fig. 4. *Elytrophorus spicatus:*—*I,* flowering glume and palea.

Fig 5. *Aristida anthoxanthoides:*—*J,* spikelet.

Fig. 6. *Aristida latifolia* var. *minor:*—*K,* spikelet; *L,* leaf.

Fig. 7. *Aristida echinata:*—*M,* spikelet; *N,* flowering glume.

Fig. 8. *Aristida Browniana.*

Fig. 9. *Aristida biglandulosa:*—*O,* spikelet; *P,* flowering glume; *Q,* base of panicle-branch showing glands.

Fig. 10. *Eragrostis elongata:*—*R,* portion of panicle; *S,* spikelet; *T,* flowering glume; *U,* palea; *V,* grain.

Plate IX.

Fig. 1. *Nicotiana ingulba:*—*A,* limb of corolla; *B,* calyx; *C,* capsule.

Fig. 2. *Bassia articulata.*

Fig. 3. *Frankenia granulata:*—*D,* one valve of capsula; *E,* cross section of leaf; *F,* leaf.

Fig. 4. *Swainsona uniflora:*—*G,* pistil; *H,* standard.

Fig. 5. *Hibiscus crassicalyx:*—*I,* flower; *J,* imbricate petals and large base of same; *K,* pistil.

Fig. 6. *Eriachne Isingiana:*—*L,* back of flowering glume; *M,* palea and grain; *N* spikelet.

NEW AUSTRALIAN LEPIDOPTERA.

By A. Jefferis Turner, M.D., F.E.S.

[Read October 12, 1933.]

Family LARENTIADAE.

Poecilasthena cisseres, n. sp.

κισσηρης, ivy-green.

♀, 28 mm. Head grey-whitish; face brownish; fillet white. Palpi under 1; brown-whitish. Antennae whitish. Thorax dull bluish-green. Abdomen dull bluish-green; apex whitish; underside pale grey. Legs pale fuscous; posterior pair whitish. Forewings triangular, costa moderately arched, apex pointed, termen nearly straight, moderately oblique; dull bluish-green with white markings; costal edge grey throughout; antemedian line from ¼ costa to ⅖ dorsum, slightly curved outwards, slender, indistinct towards costa; postmedian from ⅗ costa to ⅝ dorsum, stronger, slightly outwardly curved, becoming sinuate towards dorsum; cilia pale grey. Hindwings with termen strongly rounded; as forewings but lines more approximated.

Very distinct, but nearest *P. euphylla* Meyr.

Victoria: Moe, in February; one specimen.

Family OENOCHROMIDAE.

Taxeotis limbosa, n. sp.

limbosus, fringed.

♀, 22 mm. Head and thorax dark grey. Palpi 2; pale ferruginous-brown with a sharply defined white basal area. Antennae fuscous. Abdomen and legs fuscous. Forewings triangular, costa straight, apex rectangular, termen almost straight, scarcely oblique, crenulate; dark grey slightly tinged with brownish; some whitish costal strigulae; fuscous dots on costa at ⅓ and ⅗; a brownish discal dot slightly beyond middle; a subterminal series of blackish streaks on veins ending in terminal dots, each interrupted by a white dot; a very fine blackish terminal line; cilia grey sprinkled with fuscous, apices and a postmedian line grey-whitish. Hindwings with termen gently rounded, crenulate; dark grey, a terminal series of dark fuscous dots; cilia as forewings.

Very distinct but probably nearest *T. exsectaria* Wlk.

Western Australia: Perth; one specimen received from Mr. W. H. Matthews.

Tapinogyna oxypeuces, n. sp.

ὀξυπευκης, sharp-pointed.

♂, 30-35 mm. Head, thorax, and abdomen grey. Palpi slightly over 1; dark fuscous. Antennae grey; pectinations in male 3. Legs fuscous. Forewings triangular, costa slightly arched, apex acute, termen straight, slightly oblique; grey with a few fuscous scales; lines fuscous, variably developed; antemedian from beneath ⅓ costa to ¼ dorsum, slightly curved, often obsolete; postmedian from beneath ⅔ costa to ¾ dorsum, slightly sinuate, pale-edged posteriorly; it may be obsolete leaving only a pale line; a pale dentate subterminal line immediately preceded by a series of fuscous dots; a dark fuscous discal dot beneath midcosta;

an interrupted terminal line; cilia grey. Hindwings with termen gently rounded; as forewings but without antemedian line.

♀, 35 mm. Similar but wings darker and all markings obsolete.

Structurally a *Tapinogyna*, this species looks like a *Nearcha.* It is larger than *T. perichroa* Low., the sexes of equal size, and the apex of the forewings much more acute. In both sexes 6 and 7 of hindwings are separate, 7 arising before angle.

Queensland: Milmerran, in September; four specimens.

Family SYNTOMIDAE.

Eressa stenothyris, n. sp.

στενοθυρις, narrowly transparent.

♂, 28 mm. Head orange. Palpi fuscous. Antennae dark fuscous; pectinations in male 1½. Thorax fuscous with anterior and posterior orange spots. Abdomen orange, bases of segments fuscous. Legs dark fuscous; posterior pair pale ochreous. Forewings broadly triangular, costa straight to near apex; apex rounded. termen slightly rounded, slightly oblique; fuscous with pale ochreous spots; a sub-basal spot at ⅓ with a long, narrow posterior process; two median spots placed transversely, the lower smaller; a subcostal spot at ⅗; twin spots placed transversely before midtermen; cilia fuscous. Hindwings moderate, emarginate beyond tornus; fuscous; a long, narrow spindle devoid of scales, narrowly edged with ochreous on anal vein; a pale ochreous sub-basal dot; a small subapical spot with a dot just beneath; cilia fuscous.

Queensland: Yeppoon, in December; one specimen received from Mr. E. J. Dumigan.

Family NOCTUIDAE.

Gen. **Hedymiges,** nov.

ἡδυμιγης, sweetly blended.

I substitute this name for *Cycloprora* (Turn., P.L.S.N.S., 1931, p. 338), which I had previously used in this family in a different sense. Type *H. aridoxa* Turn. The type of *Cycloprora* is *C. nodyna* Turn.

Cycloprora symprepes, n. sp.

συμπρεπης, decorous.

♀, 38 mm. Head white; a blackish dot between antennae, and a blackish transverse line across middle of face. Palpi 1½; white, second joint except apex blackish. Thorax white; lateral and posterior margins blackish. Abdomen white sprinkled with fuscous, appearing pale grey. Legs blackish with white rings. Forewings elongate-triangular, costa slightly arched, apex rectangular, termen straight, not oblique, rounded beneath; white with fuscous irroration, appearing grey; markings blackish; two slender transverse lines from costa near base, succeeded by a small costal blotch; a round white sub-basal dorsal spot, containing a blackish dot before middle; a slender dentate transverse line at ⅓; orbicular a small circular ring slenderly outlined; reniform larger, broadly bilobed; between these a suffused median line bent outwards in middle; two dentate lines follow reniform; a white terminal band containing three blackish spots and a fine broken dentate line; cilia blackish with white bars. Hindwings with termen wavy; fuscous, paler towards base; a curved dentate postmedian line; two whitish tornal spots; cilia white with fuscous bars.

Queensland: Yeppoon, in December; one specimen received from Mr. E. J. Dumigan.

Namangana fulvescens, n. sp.

fulvescens, partly yellowish-brown.

♂, 36-39 mm. Head fuscous-brown. Palpi 1; fuscous-brown. Antennae grey; ciliations in male minute. Thorax fuscous; anterior and posterior crests whitish. Abdomen brown. Legs brown; tarsi fuscous with whitish rings. Forewings elongate-triangular, costa almost straight, apex rectangular, termen strongly rounded, crenulate; dark fuscous; orbicular obscurely ringed; reniform pale outlined with blackish; between them a blackish suffusion; postmedian line double, slender, wavy, strongly angled above middle; a blackish triangular subapical costal spot containing two pale marginal dots; terminal area whitish-grey with some grey suffusion; within this a short series of fuscous dots from dorsum; cilia fuscous, apices partly whitish. Hindwings with a termen rounded, wavy; pale orange-brown; a broad fuscous terminal band; cilia as forewings.

Queensland: Yeppoon, in December; two specimens received from Mr. E. J. Dumigan.

Gen. AMPHIPYRA Ochs.

Peripyra Hmps. is not, I think, distinguishable from this genus.

Amphopyra rubripuncta, n. sp.

rubripunctus, with red dots.

♂, 42 mm. Head and thorax fuscous. Palpi fuscous; terminal joint and apex of second joint whitish. Antennae grey; ciliations in male ½. Abdomen fuscous; apices of tuft whitish. Legs fuscous. Forewings elongate-triangular, costa straight to near apex, apex rounded, termen rounded, slightly oblique; grey with dark fuscous markings and red dots; three transverse striae from costa near base, the middle one ending in a red dot; antemedian line strongly dentate, from ¼ costa to mid-dorsum; orbicular and reniform small, dark fuscous with red centre, an additional similar spot posterior to reniform; postmedian line double, finely dentate, outwardly curved from ⅗ costa, below middle, more strongly dentate to ¾ dorsum; a subterminal shade, posterior margin sharply defined with minute red dots; a terminal series of dark fuscous dots; cilia grey. Hindwings with termen rounded, slightly waved; pale fuscous; cilia pale fuscous.

South Australia: Mount Lofty (1,500 feet), in February; one specimen.

Araeoptera imbecilla, n. sp.

imbecillus, weak.

♂, 10 mm. Head, thorax and antennae white. Palpi fuscous. Forewings elongate-triangular, costa gently arched, apex pointed, termen slightly rounded, strongly oblique; white with some fuscous suffusion towards apex; a costal dot at ⅓; a median dark fuscous fascia from midcosta, obsolete towards dorsum; some terminal dark fuscous dots; cilia white with a few fuscous points. Hindwings triangular, apex pointed, termen straight; white with some fuscous suffusion; a blackish discal dot before middle, and another on mid-dorsum; cilia as forewings.

North Queensland: Babinda, near Innisfail, in September, one specimen.

Eublemma amphidasys, n. sp.

ἀμφιδασυς, fringed all round.

♀, 16 mm. Head and thorax dark fuscous. Palpi 1½; ochreous. Antennae grey. Abdomen dark fuscous; apex and underside ochreous. Legs fuscous; posterior pair mostly pale ochreous. Forewings triangular, costa nearly straight,

apex subrectangular, termen rounded, scarcely oblique; purple-fuscous with broadly suffused transverse lines partly confluent; five minute ochreous—white costal dots between middle and apex; cilia ochreous-white with a median fuscous bar. Hindwings with termen rounded; fuscous; cilia ochreous-white.

Nearest *E. iophaënna* Turn.

Queensland: Brisbane, in January; one specimen.

Oruza megalospila, n. sp.

μεγαλοσπιλος, large-spotted.

♀, 26 mm. Head, palpi, antennae, thorax, abdomen, and legs grey. Forewings elongate-triangular, costa almost straight, apex obtusely pointed, termen gently rounded, moderately oblique; grey; a fuscous sub-dorsal dot near base; two or three similar dots in disc at ⅙; a small fuscous spot at ⅓ representing orbicular; reniform oval, fuscous; just posterior to reniform a large circular ferruginous spot edged with fuscous; a suffused fuscous spot between this and costa; another similar on dorsum before tornus; a series of dark fuscous dots near termen; cilia grey. Hindwings with termen slightly rounded; grey; two fine median lines angled posteriorly in middle; a subterminal series of dark fuscous dots; submarginal dots and cilia as forewings.

North Queensland: Kuranda, in March; one specimen received from Mr. F. P. Dodd.

Stictoptera aequisecta, n. sp.

aequisectus, equally divided.

♂, 50 mm. Head ochreous-whitish. Palpi grey, anterior surface brown. Antennae grey; a fan-shaped internal tuft of scales on basal joint; ciliations in male ½. Thorax with high erect tufts of scales from inner surfaces of patagia meeting in middle line, and a small posterior tuft; grey-brown, anteriorly ochreous-whitish. Abdomen pale grey, posteriorly darker. Legs grey-brown; posterior pair mostly ochreous-whitish. Forewings narrow, only slightly dilated, costa almost straight, apex pointed, termen slightly rounded, strongly oblique, crenulate; pale grey suffused with brown on costa before middle, and more broadly in tornal area; two irregularly crenulate transverse lines at ¼; orbicular circular, pale with fuscous centre, posteriorly edged with blackish; claviform a blackish V-shaped mark with apex posterior; a blackish line from midcosta to ⅔ dorsum; very slightly waved; reniform broad, pale with fuscous centre and edged with blackish except beneath; postmedian line double, from ¾ costa outwardly curved and then inwardly to before tornus, three blackish spots on its outer edge below middle; a pale dentate subterminal line; a brownish subapical costal spot containing two blackish streaks; three blackish streaks before subterminal below middle; a fine blackish line from subterminal to termen beneath apex, and others similar between veins; cilia pale grey. Hindwings ample, termen rounded, bisinuate; without scales and translucent, except veins and a terminal band not reaching tornus, which are blackish; cilia whitish.

Queensland: Yeppoon, in December; one specimen received from Mr. E. J. Dumigan.

Gen. Cryphimaea, nov.

κρυφιμαιος, hidden.

Tongue present. Palpi porrect; second joint broadly dilated, laterally compressed; terminal joint very short, obtuse. Abdomen with dorsal tufts on first three segments. Forewings without areole, 2 from ⅔, 3 from before angle, 4 and 5 approximated at origin, 6 from upper angle, 7 and 8 stalked, 9 and 10 absent.

Hindwings with 2 from $\frac{2}{3}$, 3 and 4 coincident, 5 well separate, 6 and 7 stalked, 12 anastomosing with cell to $\frac{1}{3}$.

Nearest *Microthripa*, distinguished by the loss of two veins in the forewing.

Cryphimaea poliophasma, n. sp.

πολιοφασμα, a grey phantom.

♀, 20 mm. Head grey-whitish. Palpi 3; pale grey. Antennae pale grey. Thorax grey; patagia grey-whitish with a small anterior median brownish spot. Abdomen grey. Legs fuscous; posterior pair pale grey. Forewings suboblong, costa strongly arched, apex rounded-rectangular, termen rounded, not oblique; pale grey; markings fuscous, obscure; a suffused irregular line from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum; a slender sinuate line from $\frac{3}{4}$ costa to $\frac{3}{4}$ dorsum; an imperfect dentate subterminal line; cilia pale grey. Hindwings and cilia pale grey.

Queensland: Yeppoon, in December; one specimen received from Mr. E. J. Dumigan.

Gen. Dumigania, nov.

Tongue strong. Palpi short, ascending, not reaching vertex. Thorax with a posterior crest. Abdomen with a crest on basal segment. Forewings with a strong tooth of scales on tornus; 2 from $\frac{2}{3}$, 3 from angle, 4 and 5 well separate, 6 from upper angle, areole very small, 7, 8, 9 stalked from areole, 10 separate. Hindwings with 2 from $\frac{3}{4}$, 3 and 4 approximated from angle, 5 well separate, strongly developed, curved towards 4 near base, 6 and 7 connate, 12 anastomosing shortly with cell at $\frac{1}{5}$.

I have much pleasure in dedicating this genus to its discoverer. Although the male is unknown, it is probably one of the *Acontianae*.

Dumigania iochlora, n. sp.

ἰοχλωρος, purple-green.

♀, 32 mm. Head reddish-purple. Palpi 1; fuscous. Antennae grey. Thorax reddish-purple. Abdomen pale grey; basal crest purple. Legs dark fuscous with whitish rings; posterior pair mostly whitish. Forewings triangular, costa straight to $\frac{3}{5}$, thence bisinuate, apex round-pointed, termen angled on vein 4, slightly crenulate; reddish-purple; base and costa to middle suffused with white; costa with some dark fuscous irroration before middle; a fine blackish line from $\frac{2}{5}$ costa to $\frac{2}{5}$ dorsum; acutely angled outwards on fold; a similar line from $\frac{4}{5}$ costa, gently curved inwards to fold, where it is connected to the antemedian line, thence outwardly curved to $\frac{4}{5}$ dorsum; a white terminal band, edged anteriorly with grey-green suffusion; a grey-green terminal line; cilia fuscous, apices white. Hindwings with termen rounded, bisinuate; whitish, towards termen grey; a fine fuscous postmedian line; cilia whitish with several fuscous bars.

Queensland: Mount Tambourine, in March; one specimen received from Mr. E. J. Dumigan.

Plusia didymospila, n. sp.

διδυμοσπιλος, twin-spotted.

♀, 34 mm. Head, palpi, and thorax fuscous-brown. Antennae fuscous. Abdomen grey. Legs fuscous. Forewings elongate-triangular with a strong scale-tuft at tornus, costa slightly arched, apex pointed, termen rounded, slightly oblique; grey partly suffused with fuscous-brown; a short pinkish-white interrupted sub-basal transverse line; a similar line from $\frac{1}{3}$ costa to $\frac{1}{4}$ dorsum, slightly curved outwards; a pale dentate line from $\frac{2}{3}$ costa to $\frac{3}{4}$ dorsum, toothed inwards on fold; orbicular obsolete; reniform indistinctly darker, with two silvery dots, one on anterior and one on posterior margin below middle; an oblique oval

silvery spot immediately after midpoint of antemedian line, and a similar spot below and posterior, nearly touching postmedian line on fold; a subterminal dark shade, well defined posteriorly, with a large posterior tooth beneath costa; a dark terminal lunule on midtermen and three smaller lunules above it; cilia grey, tornal tuft fuscous. Hindwings with termen rounded, slightly wavy; grey, paler towards base; cilia grey with a dark sub-basal line.

North Queensland: Kuranda; one specimen received from Mr. F. P. Dodd.

Nyctipao phaea, n. sp.

φαιος, dusky.

♂, ♀, 104-146 mm. Head, thorax, abdomen, and legs fuscous. Palpi with second joint scarcely reaching vertex, terminal joint ¾; fuscous. Antennae fuscous; ciliations in male minute, bristles ½. Forewings triangular, broader in female, costa slightly arched, more strongly towards apex, termen nearly straight, scarcely oblique, strongly crenulate; fuscous; a darker sub-basal line, in female gently rounded, in male strongly waved; a large round antemedian ocellus edged by a dark fuscous line except on costal side, outside this a pale line on lower and outer side, running to midcosta, sometimes white as it approaches costa; ocellus contains on its inner side a brown blackish-edged lunate area with a bidentate process below middle, lower part of edge doubly defined by bluish-white scales; a dark fuscous line from ocellus, commencing with a posterior tooth, in female wavy to ⅛ dorsum, in male straight to ¼ dorsum; a line from ¾ costa to ⅓ dorsum, nearly straight, being the anterior edge of a slightly paler area; a large triangular dark fuscous subapical blotch containing a pale or white subapical spot; from this blotch a strongly crenate line to ¾ dorsum, interrupted in middle, dark fuscous edged anteriorly with a narrow pale or white line; a small dark fuscous blotch opposite the gap in postmedian line, containing a small posterior pale or white spot; cilia fuscous. Hindwings as forewings but without sub-basal line. Underside with posterior white marks larger and better defined.

Nearest *N. leucotaenia* Clerck, but without its white fascia.

North Queensland: Cairns; Palm Island, in June; Ingham, in April; five specimens.

ATTATHA REGALIS Moore.

Proc. Zool. Soc., 1872, p. 575, Lep. Ceyl. iii., pl. 212, fig. 4. Hmps. Lep. Phal, xiii., p. 8.

♀, 46 mm. Head pale ochreous-grey, pinkish-tinged; upper half of face blackish. Palpi blackish; lower surface and base of second joint reddish. Antennae grey. Thorax pale ochreous grey with anterior, median, and posterior blackish lines. Abdomen orange-brown; beneath reddish. Legs blackish; coxae and posterior tibiae red. Forewings triangular, costa nearly straight, apex pointed, termen straight, not oblique, rounded beneath; pale ochreous-grey with blackish markings; a very short median streak from base; a dorsal streak from near base to beyond middle; a triangular median costal blotch with a long oblique process towards tornus; a triangular subapical costal blotch; two terminal spots below middle; a suffused reddish tornal spot; cilia pale ochreous-grey. Hindwings with termen rounded; bright red; several minute fuscous terminal dots; cilia reddish-grey. Underside reddish with a suffused oblique median mark on forewing, and a series of terminal dots on hindwing, blackish.

North Queensland: Banks Island (Australian Museum).

Queensland: Yeppoon, in December; one specimen received from Mr. E. J. Dumigan.

Erceia spilophracta, n. sp.

σπιλοφρακτος, with spotted edge.

♂, 38-43 mm. Head and thorax fuscous with a few whitish points. Palpi ascending, appressed to face; second joint rough on anterior edge only, reaching vertex; terminal joint ⅔, stout, obtuse; fuscous, apices of second and terminal joints whitish. Antennae fuscous; in male bipectinate, pectinations slender, 1½, each with a long terminal bristle. Abdomen and legs fuscous. Forewings triangular, costa almost straight, apex rectangular, termen rounded, not oblique; fuscous; markings pale ferruginous; a wavy transverse line at ⅕; orbicular and reniform obscurely indicated; a whitish spot on ⅗ costa, from which proceeds a sinuate line of dots to a spot on ⅗ dorsum; a faint subterminal line; a series of terminal dots on veins; cilia fuscous; Hindwings as forewings but without sub-basal line.

In the type the areole has been lost by the failure of the basal part of vein 9 to chitinise, leaving 10 separate and 7, 8, 9 stalked. In a second example the structure is that typical of the genus, a small areole from the apex of which 8, 9, 10 arise by a common stalk, 7 being connate with them.

Queensland: Yeppoon, in December; Brisbane, in January; two specimens.

Gen. Brachycyttara, nov.

βραχυκυτταρος, with short cell.

Tongue strong. Palpi ascending, not reaching vertex; second joint densely hairy; terminal joint moderate, smooth, obtuse. Antennae of male with tufts of short cilia. Head with loose-haired crest on vertex. Thorax with rounded anterior but no posterior crest. Abdomen with well-developed crests on first three segments. Femora and tibiae densely hairy. Forewings with normal neuration. Hindwings with cell short (⅓); 3 and 4 short-stalked, 5 well developed from near above angle (⅕), 6 and 7 connate, 12 anastomosing with cell near base.

Brachycyttara crypsipyrrha, n. sp.

κρυψιπυρρος, with hidden red.

♂, 40 mm. Head and thorax fuscous with a few whitish hairs. Palpi with terminal joint ⅗; fuscous sprinkled with whitish. Antennae whitish-brown; ciliations in male ¾. Abdomen grey. Legs fuscous with some whitish hairs. Forewings elongate-triangular, costa almost straight but slightly sinuate, apex pointed, termen long, moderately rounded, wavy, oblique; fuscous; several minute dots ferruginous-red, one in middle near base, one at and another beneath end of cell, fourth and fifth above and below middle preceding postmedian line; ill-defined antemedian and median dark fuscous transverse lines; stigmata obsolete; postmedian line double, finely waved, outwardly curved, from ⅔ costa to ⅔ dorsum, edged posteriorly by a pale line; a fine pale dentate subterminal line; fine dark fuscous submarginal and terminal lines; cilia fuscous-whitish with dark median and terminal lines. Hindwings with termen rounded, crenulate, whitish; towards termen sprinkled with fuscous, especially on veins; a fuscous terminal line; cilia whitish with fuscous bars.

New South Wales: Bourke (Helms); two specimens received from Mr. G. M. Goldfinch, who has the type.

Fodina miranda, n. sp.

mirandus, wonderful.

♀, 45 mm. Head brown; fillet whitish. Palpi 3½; second joint red sprinkled with fuscous on outer surface; terminal joint ½; fuscous, apex whitish. Antennae

grey. Thorax brown with antemedian and postmedian whitish transverse lines. Abdomen grey-brown. Legs reddish; tarsi and anterior tibiae pale fuscous. Forewings triangular, costa slightly arched, more strongly towards apex, apex rectangular, termen nearly straight, slightly oblique; grey; costal edge reddish; a small subcostal subquadrate brown basal blotch; a large dark brown blotch extending on dorsum from near base to $\frac{3}{4}$, its costal edged curved to $\frac{3}{8}$, thence abruptly angled towards dorsum, but soon deeply excavated, angled again sharply above dorsum, edged in disc with whitish; a similar large apical blotch, but paler on costa, on which it extends from $\frac{3}{8}$ to apex, triangular, ending obtusely above tornus, narrowly separated from termen; cilia grey, apices whitish. Hindwings with termen rounded, crenulate; orange; a terminal band, straight-edged, broad at apex, not reaching tornus; cilia fuscous, on tornus and dorsum orange.

North Queensland: Kuranda, in November; one specimen received from Mr. F. P. Dodd.

Fodina pergrata, n. sp.

pergratus, delightful.

♂, 42 mm. Head reddish-white; face red. Palpi $2\frac{1}{2}$; red, outer surface sprinkled with fuscous; terminal joint $\frac{1}{3}$. Antennae pale grey; in male shortly ciliated ($\frac{1}{4}$) with a pair of bristles ($\frac{1}{2}$) on each segment. Thorax reddish-brown; crest dark fuscous. Abdomen pale ochreous; tuft reddish-tinged. Legs reddish; tarsi pale fuscous. Forewings triangular, costa nearly straight (apex broken), termen rounded, not oblique; reddish-grey; an irregular dark fuscous blotch commencing as a sub-basal fascia from dorsum, upper edge oblique to beneath $\frac{1}{3}$ costa, longitudinal to near middle, bent at a right angle towards dorsum, then curved outwards to a sharp-toothed projection, lower edge sinuate, ending on $\frac{1}{3}$ dorsum, whitish-edged; a whitish line from beneath costa before apex to apex of discal blotch, with a strong anterior tooth above middle, posteriorly edged with dark fuscous, more broadly opposite supramedian tooth; terminal area greyer; cilia grey. Hindwings with termen rounded; yellow; a moderate fuscous terminal band; cilia fuscous, on dorsum yellow.

North Queensland: Cape York, in October; one specimen received from Mr. E. J. Dumigan.

Pantydia dochmosticha, n. sp.

δοχμοστιχος, with oblique line.

♂, 56 mm. Head grey-brown. Palpi $1\frac{1}{2}$, terminal joint $\frac{1}{4}$; dark fuscous, terminal joint grey-brown. Antennae grey-brown; in male minutely ciliated with a pair of short bristles ($\frac{1}{2}$) on each segment. Thorax grey-brown; tegulae paler; patagia dark fuscous. Abdomen grey-brown. Legs fuscous. Forewings elongate-triangular, costa straight to near apex, apex rectangular, termen rounded, slightly oblique; grey-brown with sparsely scattered dark fuscous scales; an oblique brown line from $\frac{2}{3}$ costa to mid-dorsum, becoming indistinct towards costa; three brown dots, one above and two below middle, representing subterminal line; cilia grey-brown. Hindwings with termen gently rounded; fuscous-brown with some dark fuscous irroration towards dorsum and termen; cilia grey-brown.

North Queensland: Kuranda; one specimen received from Mr. F. P. Dodd.

Anomis microphrica, n. sp.

ημκροφρικος, minutely rippled.

♀, 32 mm. Head and thorax pale reddish-grey. Palpi $1\frac{1}{2}$; whitish sprinkled with reddish-grey. Antennae whitish-grey. Abdomen and legs pale grey. Forewings elongate-triangular, costa straight almost to apex, apex subrectangular, termen sinuate, scarcely oblique; pale reddish-grey with numerous very fine trans-

verse strigulae; a white discal dot beneath 1/3 costa, and another beyond middle nearer mid-disc; cilia grey. Hindwings with termen rounded; pale reddish-grey; cilia pale grey.

North Australia: Darwin; one specimen received from Mr. G. F. Hill.

Gen. **Baryphanes**, nov.

βαρυφανης, heavy-looking.

Tongue strong. Palpi long, obliquely ascending; second joint thickened with loose hairs; terminal joint short, porrect, obtuse. Thorax and abdomen without crests. Femora and tibiae densely hairy. Forewings with 2 from 2/3, 3 from well before angle, 4 from angle, 5 approximated, 6 from upper angle, areole long, 7 and 10 arising from it separately, 11 from about middle. Hindwings with 2 from middle, 3 from well before angle, 4, 5 connate from angle, 6 and 7 approximated from angle.

Baryphanes niphosema

Monoctenia niphosema Low. Trans. Roy. Soc., S. Aust., 1908, p. 114.

♀, 52 mm. Head and thorax pale reddish-brown. Palpi 3; grey; towards base sprinkled with red. Antennae grey, towards base pale reddish. Abdomen grey. Legs grey sprinkled with red. Forewings elongate-triangular, costa nearly straight, slightly sinuate, apex pointed, slightly produced, termen strongly rounded, oblique; pale reddish-brown; a fuscous sub-basal dot beneath costa; a small white spot outlined with fuscous beneath 1/3 costa; a transversely oval grey spot outlined with fuscous beneath midcosta; a faint wavy transverse line from 3/4 costa to 3/4 dorsum; a parallel series of fuscous dots between this and termen; cilia reddish, apices grey. Hindwings with termen rounded; grey; cilia grey.

Western Australia: Perth; one specimen received from Mr. L. J. Newman.

Avitta quadrilinea Wlk.

Journ. Lin. Soc., vii., p. 171 (1864). Hmps., Moths, India, iii., p. 29.

Bocana quadrilinealis Moore, Proc. Zool. Soc., 1867, p. 88.

♂, 50 mm. Head and thorax fuscous-brown. Palpi erect, exceding vertex, second joint much thickened, slightly rough, terminal joint 2/3, smooth, obtusely pointed; pale fuscous-brown. Antennae 3/4; fuscous; in male with bilateral tufts of short cilia (1/2) on each segment. Abdomen and legs fuscous. Forewings elongate, suboblong, apex round-pointed, termen rounded, oblique; fuscous-brown; four nearly straight oblique dark fuscous transverse lines; first from 1/4 costa to dorsum near base; second from midcosta to 2/3 dorsum; third from 3/5 costa to 3/5 dorsum; fourth from costa near apex to dorsum before tornus; a slender fuscous irregularly dentate subterminal line; cilia fuscous with a pale basal line. Hindwings with termen strongly rounded; fuscous; cilia fuscous, apices paler.

North Queensland: Kuranda; one specimen received from Mr. F. P. Dodd.

Gen. **Orthozancla**, nov.

ὀρθοζαγκλος, with erect sickles.

Tongue strong. Palpi very long, ascending, appressed to face; second joint exceeding vertex, thickened with smoothly appressed hairs, but with rough hairs posteriorly towards apex; terminal joint long, stout, obtusely pointed, with a small posterior tuft at apex. Antennae in male bipectinate, pectinations long, not quite reaching apex. Thorax and abdomen without crests. Forewings with 2 from 4/5, 3 from angle, 4 and 5 separate, 6 from upper angle, areole present, from it 7

connate with stalk of 8, 9, 10 arising separately from areole, 11 from $\frac{2}{3}$. Hindwings with cell about $\frac{2}{3}$, 2 from $\frac{4}{5}$, 3 and 4 stalked from angle, 5 well developed from above angle ($\frac{1}{4}$), 6 and 7 connate, 12 anastomosing with cell near base.

Orthozancla rhythmotypa, n. sp.

ῥυθμοτυπος, with symmetrical markings.

♂, 26 mm. Head, thorax, and abdomen fuscous. Palpi $3\frac{1}{2}$; second joint much exceeding vertex, terminal joint $\frac{1}{3}$; fuscous. Antennae fuscous; pectinations in male 4, each ending in a long bristle, extreme apex simple. Legs fuscous. Forewings triangular, costa bisinuate, apex very obtusely pointed, termen bowed on vein 4; brownish-fuscous with some whitish irroration; a small elongate triangular white area on costa from middle to $\frac{7}{8}$; three darker transverse lines; antemedian from $\frac{1}{4}$ costa obliquely outwards, interrupted by orbicular, with a small tooth beneath this, then inwardly oblique to $\frac{1}{3}$ dorsum, edged anteriorly by a pale line; median more suffused, oblique, passing beyond reniform, there rounded inwards and oblique to $\frac{2}{3}$ dorsum; postmedian from $\frac{3}{4}$ costa, outwardly oblique, traversing white area, then rounded inwards and sinuate to before tornus, edged posteriorly by a pale line; orbicular small, circular, pale with brown centre; reniform pale, small, lunate; a wavy subterminal line faintly indicated; cilia fuscous, on costa before apex white. Hindwings subquadrate, termen rounded; as forewings, but without first line; a fuscous discal dot at $\frac{1}{3}$.

Queensland: Montville (1,500 feet), near Nambour, in February; one specimen received from Mr. E. J. Dumigan.

Tamba grandis, n. sp.

grandis, large.

♀, 48 mm. Head brown, face whitish. Palpi 3, erect, second joint exceeding vertex, terminal joint $\frac{2}{5}$, stout, obtuse, whitish-grey. Antennae grey. Thorax pale grey; patagia brown. Abdomen whitish-grey with brown suffusion. Legs brown; posterior pair pale grey. Forewings triangular, costa straight except near base and apex, termen angled on vein 4, concave above, oblique below, wavy; brown with a few blackish scales; markings whitish-grey; a basal patch, its posterior edge outwardly oblique from costa to a sharp tooth, thence inwardly oblique, a moderately oblique fascia containing a brown costal spot and another in disc before and beneath; anterior edge irregular from $\frac{1}{3}$ costa to $\frac{1}{4}$ dorsum, posterior edge nearly straight from $\frac{3}{4}$ costa to mid-dorsum; a small spot beyond this below middle; a large roundish apical blotch; three small blackish spots between this and tornus; cilia brown with a whitish basal line, on apical blotch whitish-grey. Hindwings angled and toothed on vein 4, crenulate; colour and cilia as forewings; a whitish-grey basal patch, posterior edge straight; a narrow marginal blotch from tornus to mid-dorsum, containing a brown spot; a whitish line from $\frac{3}{4}$ costa to tornal blotch.

North Queensland: Kuranda; one specimen received from Mr. F. P. Dodd.

Adrapsa tapinostola, n. sp.

ταπεινοστολος, plainly clothed.

♂, 34 mm. Head, thorax, and abdomen pale brownish-grey. Palpi ochreous-whitish sprinkled with fuscous. Antennae pale grey; in male unipectinate, pectinations short ($\frac{1}{2}$), slender, a pair of long bristles (4) from base of each pectination. Forewings triangular, costa straight, apex pointed, termen sinuate beneath apex, strongly bowed on vein 4; pale brownish-grey sparsely sprinkled with fuscous; markings fuscous; a wavy line from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum;

another from costa beyond middle to dorsum before middle; a crenulate line from ¾ costa to ¾ dorsum, curved outwards beneath costa; a subterminal series of dots; a terminal line; cilia fuscous, bases paler. Hindwings subquadrate, termen angled on vein 4; as forewings but without antemedian line.

Queensland: Mount Tambourine, in March; one specimen received from Mr. E. J. Dumigan.

Hypenodes mesoscia, n. sp.

μεσοσκιος, with median shade.

♀, 17 mm. Head and thorax whitish. Palpi 4; whitish with a few fuscous scales. Antennae grey. Abdomen grey; apices of segments and tuft whitish. Legs whitish sprinkled with fuscous; anterior and middle tarsi fuscous. Forewings elongate-triangular, costa almost straight, apex acute, slightly produced, termen strongly angled on vein 4, concave above angle, straight and oblique below; whitish with some pale fuscous irroration and suffusion; three fuscous dots forming an oblique sub-basal line; antemedian line oblique, wavy, indistinct, from ⅓ costa to ⅙ dorsum; a median shade, its anterior edge defined, straight, from midcosta to ⅓ dorsum; postmedian from midcosta strongly curved outwards, then straight to mid-dorsum; the area between this and median shade pale fuscous; blackish dots on costa at ⅓, middle, and three between middle and apex; a blackish dot in disc at ⅔ before postmedian line; a subterminal line of blackish dots; a strong blackish median bar from subterminal line to termen and through cilia; fine submarginal and terminal blackish lines; cilia grey-whitish with a postmedian fuscous line. Hindwings with termen strongly toothed on veins 4 and 7; not rounded; colour, marginal lines, and cilia as forewings; a narrow fuscous and blackish bar from mid-dorsum, and a sinuate dotted line from ¾ dorsum, both ending about mid-disc.

North Queensland: Mackay, in August; one specimen.

HYPENA CAERULEALIS Wlk.

Cat. Brit. Mus., xxxiv., p. 1,142.

I am indebted to Miss A. E. Prout for pointing out that this is distinct from *H. masurialis* Gn. In that species there is a marked difference between the sexes, the male being larger and with the apices of the forewings more acute. The females of the two species are very similar. *H. caerulealis* has a suffused whitish subcostal streak running into the apex of the forewing, but this varies and may be absent; also the postmedian line is more or less irregularly waved or rippled; that in *H. masurialis* is almost straight, not rippled, and edged posteriorly by a pale line. I am informed that the two species can be separated by their genitalia.

North Queensland: Cairns: Dunk Island; Herberton. Queensland: Brisbane.

Family LIMACODIDAE.

DORATIFERA OCHROPTILA Turn.

Through the kindness of Mr. Geo. Lyell I have seen four examples of this species, two of each sex, expanding in the male 32-34 mm., in the female 42-44 mm., from Mount Guide Station 25 miles south of Mount Isa, North Queensland. They were obtained by Mr. J. G. Mackellar from cup-shaped cocoons similar to those of *D. vulnerans* attached to twigs. This is an interesting discovery, and adds another species to those common to North-west Australia and West Queensland. Species attached to the dry districts of the interior frequently have a wide range.

Antennal pectinations in male 2, ceasing rather abruptly at ½.

Family PYRALIDAE.

Gen. **Hypermeces**, nov.

ὑπερμηκης, very long.

Tongue strong. Labial palpi rather long, porrect; second joint thickened with appressed scales; terminal joint short, curved downwards. Maxillary palpi obsolete. Forewings with 2 from ¾, 3, 4, 5, approximated from angle, 6 from upper angle, 7, 8, 9, stalked, 10 from end of cell closely approximated to 9, 11 from ⅘. Hindwings with cell short (about ¼), 2 from ⅘, 3, 4, 5, approximated from angle, 6, 7, connate from upper angle, 7 anastomosing strongly with 12.

Hypermeces xanthochyta, n. sp.

ξανθοχυτος, yellow-stained.

♀, 45 mm. Palpi 1¼; pale ochreous. Antennae fuscous. Thorax orange with two anterior fuscous dots; tegulae with blackish basal and antemedian spots. Abdomen ochreous with interrupted fuscous dorsal bars. Legs pale ochreous; anterior pair mostly dark fuscous. Forewings narrow, elongate-triangular, costa straight to ⅔, thence arched, apex rounded, termen very obliquely rounded; whitish partly suffused with yellow between veins; markings blackish; a basal costal spot; three sub-basal spots arranged transversely; an interrupted curved transverse line at ⅙; a broad transverse median subcostal bar; a sinuate postmedian fascia composed of broad interneural bars; a line of interneural dots closely following; cilia whitish-yellow. Hindwings with termen gently rounded; whitish suffused with yellow near termen and dorsum; a slight postmedian fuscous mark; cilia as forewings.

North Queensland: Meringa, near Cairns, in December; one specimen. Type in Coll. Lyell.

Epipaschia nephelodes, n. sp.

νεφελωδης, cloudy.

♂, 32 mm. Head and thorax fuscous-brown mixed with whitish. Palpi fuscous. Antennae fuscous; in male with a short, stout basal process reaching mid-thorax, ciliations 1. Abdomen pale grey partly tinged with ferruginous. Legs dark fuscous with whitish rings; posterior tibiae mostly whitish. Forewings elongate-triangular, costa slightly arched, apex rectangular, termen slightly rounded, not oblique; fuscous partly suffused with whitish; a basal suffusion; an ill-defined dark antemedian fascia partly ferruginous, containing a blackish line from ⅖ costa, angled inwards beneath costa, and sharply downwards in middle, to mid-dorsum before tornus; a broad whitish suffusion beyond middle; a wavy line edged with whitish posteriorly from ⅔ costa obliquely outwards, sharply angled in middle, ending on dorsum before tornus; terminal area darker; a terminal series of blackish dots; cilia white with fuscous bars, on tornus ferruginous. Hindwings with termen gently rounded; pale fuscous; a faint whitish subterminal line; cilia whitish.

Queensland: Yeppoon, in December; one specimen received from Mr. E. J. Dumigan.

Family PYRAUSTIDAE.

Noorda hemileuca, n. sp.

ἡμιλευκος, half-white.

♂, 27 mm. Head and thorax white. Palpi 2; blackish, sharply white beneath towards base. Antennae fuscous; ciliations in male minute. Abdomen white; tuft fuscous above, white beneath. Legs white; anterior pair dark fuscous with white rings. Forewings elongate-triangular, costa straight for ⅘, arched before

apex, apex rounded, termen rounded, scarcely oblique; white; a costal line and a broad terminal band, its anterior edged curved, fuscous; cilia fuscous. Hindwings white; a narrow fuscous terminal band not reaching tornus; cilia fuscous, on tornus and dorsum white.

New South Wales: Acacia Plateau (3,000 feet), near Killarney (Queensland), in January; one specimen received from Mr. E. J. Dumigan.

Family COSSIDAE.

Dudgeona polyastra, n. sp.

πολυαστρος, many-starred.

♂, 54 mm.; ♀, 65 mm. Head brown; face pale yellow. Palpi brown; anterior surface pale yellow. Antennae fuscous-brown, basal joint whitish; unipectinate in both sexes, pectinations 1¼. Thorax with a posterior crest; brown with a posterior pair of white dots, tegulae shining white. Abdomen orange-brown. Legs brown with white and yellowish rings; posterior tibiae whitish-yellow. Forewings elongate-oblong, costa slightly arched, more strongly in female, apex rounded, termen slightly rounded, slightly oblique; brown with numerous circular spots, some of which are shining white, others whitish with brown strigulae; a costal series of five strigulated spots; a cluster of seven shining white spots on dorsal ⅗ of basal third; a subapical cluster of shining white spots, six in disc and six on termen, between these are numerous whitish spots, as also in costal and basal areas; cilia brown with several pale yellow bars. Hindwings with termen rounded, slightly sinuate; fuscous-brown; base and dorsum orange-brown; some paler spots near apex; cilia whitish.

Larger than *D. actinias* Turn., thoracic crest smaller, hindwings darker, forewings with more numerous spots, and antennae unipectinate.

Queensland: Yeppoon, in December; two specimens received from Mr. E. J. Dumigan.

Family TORTRICIDAE.

ACROPOLITIS HEDISTA Turn.

Trans. Roy. Soc. S. Aust., 1916, p. 504.

I took the type of this species 40 years ago in Brisbane and erroneously referred it to the genus Catamacta, the thoracic crest being denuded. Mr. W. B. Barnard took 7 examples in the Bunya Mountains in November, 1931. It is probably nearest *A. lichenica* Turn.

TORTRIX EURYSTROPHA Turn.

Trans. Roy. Soc. S. Aust., 1926, p. 135.

Tortrix hemiphoena Turn., Proc. Roy. Soc. Tas., 1926, p. 126.

The former name has two months priority.

Queensland: National Park (3-3,500 feet), Tasmania; Russell Falls; Zeehan.

Arotrophora neanthes, n. sp.

νεανθης, freshly blooming.

♂, 22 mm.; ♀ 24 mm. Head ochreous-grey. Palpi 5; ochreous-grey. Antennae in male dentate and very shortly ciliated; white sharply barred with blackish, terminal half wholly dark fuscous. Thorax ochreous-grey tinged with greenish. Abdomen grey; tuft reddish-brown. Legs fuscous; tibiae and tarsi with whitish rings; posterior pair almost wholly whitish. Forewings broadly triangular, costa slightly arched, apex subrectangular, termen straight, not oblique;

grey-green, dorsal area more or less suffused with brown; a reddish-brown subcostal streak from base to apex, where it expands and is suffusedly produced along termen to tornus; a fuscous-brown costal streak from base to $\frac{3}{5}$; a scattered sparse irroration of fugitive white scales, most abundant on costa, where they form strigulae; cilia dark fuscous, bases and a spot beneath apex reddish-brown. Hindwings broad, termen not sinuate; pale brown becoming grey towards base; cilia pale brown, on tornus and dorsum grey.

Handsome and conspicuously distinct.

Queensland: National Park (25-3,000 feet), in February and March; Bunya Mountains (3,500 feet), in March; four specimens.

Family EUCOSMIDAE.

EUCOSMA PERPLEXA Turn.

Trans. Roy. Soc. S. Aust., 1916, p. 526.

Sciaphila absconditana Wlk., Cat. Brit. Mus., xxviii., p. 351. Meyr. Proc. Lin. Soc. N.S.W., 1911, p. 248, *nec* Laharpe (1860).

Argyroploce angustifascia Turn., Trans. Roy. Soc. S. Aust., 1925, p. 58.

Queensland: Toowoomba; Bunya Mountains; Killarney; National Park. New South Wales: Sydney.

Argyroploce microlychna, n. sp.

μικρολυχνος, with tiny lights.

♀, 22 mm. Head grey-brown. Palpi $2\frac{1}{2}$; dark fuscous. Antennae grey. Thorax dark fuscous. Abdomen grey. Legs fuscous, with ochreous-whitish rings. Forewings suboblong, costa strongly arched, apex rectangular, termen gently rounded, not oblique; dark fuscous; a series of whitish costal dots, of which those in basal half give rise to short grey-metallic transverse streaks; in disc are numerous shining white dots irregularly arranged, of these some are larger, for instance one beneath costa at $\frac{1}{6}$, two on fold towards base, and a spot in disc at $\frac{3}{5}$; cilia fuscous barred with brown-whitish. Hindwings with termen sinuate; grey; cilia grey-whitish with basal and median grey lines.

Queensland: National Park (4,000 feet), in March; one specimen. Type in Coll. Barnard.

Family COSMOPTERYGIDAE.

Labdia chalcoplecta, n. sp.

χαλχοπλεκτος, brassy.

♀, 12 mm. Head and thorax brown-brassy; face whitish. Palpi blackish; second joint with a broad whitish ring before apex. Antennae dark fuscous with five whitish rings, two close together at $\frac{3}{5}$, two equally spaced between these and apex, fifth just before apex. Abdomen blackish; apices of segments and underside whitish. Legs whitish with blackish rings. Forewings narrow, apex obtusely pointed; brown-brassy; a very oblique short slender white streak from $\frac{1}{4}$ costa; a triangular white spot on midcosta, its apex prolonged to fold, edged anteriorly with blackish; a white spot on $\frac{3}{4}$ costa, outlined with blackish, connected by an interrupted longitudinal blackish streak with apex; a similar dot above tornus; a white apical dot; cilia grey, bases blackish, and also apices opposite apex of wing. Hindwings narrowly lanceolate; grey; cilia 4, grey with brassy reflections.

The convergent white costal markings together with the peculiar dots in disc should be sufficient for recognition.

Queensland: National Park (2,500 feet), in November; one specimen.

Family GELECHIADAE.

Apatetris dinota, n. sp.

δινωτος, rounded.

♂, 13 mm. Head and thorax white. Palpi with second joint somewhat dilated with loose scales towards apex, terminal joint about ½; white sprinkled with fuscous except apices of joints. Antennae whitish. Abdomen grey-whitish. Legs whitish sprinkled with fuscous; anterior pair mostly fuscous. Forewings narrow, costa strongly arched, more so towards apex, apex acute, termen and dorsum continuous, sinuate; white with fine scanty fuscous irroration; markings dark fuscous; subcostal dots at ⅛ and ⅝; a spot above mid-dorsum, obliquely placed, followed by a median dot; a subapical dot; cilia whitish with a few fuscous points. Hindwings narrow, emargination obtuse, apical process about ¼; whitish; cilia 4, whitish.

Queensland: National Park (2,500 feet), in open forest in November; one specimen.

Aristotelia ochrostephana, n. sp.

ὠχροστεφανος, with pale crown.

♂, 9 mm. Head grey-whitish. Palpi grey-whitish; second joint except apex, and a subapical ring on terminal joint, dark fuscous. Antennae fuscous. Thorax and abdomen grey. Legs fuscous with whitish rings. Forewings narrow, costa slightly arched, apex pointed, termen and dorsum continuous; 7 and 8 out of 6; grey with dark fuscous irroration and markings; costal dots at ⅙ and ⅓; a fine streak on fold from near base, just continuous with a broad oblique streak from fold nearly to midcosta; a discal dot in middle touching this streak, and another discal dot a ¾; apical area mostly dark fuscous; cilia whitish-ochreous, with dark fuscous basal bars. Hindwings narrow, apical process short, acute; pale, grey; cilia 3, pale grey.

Near *A furtiva* Meyr. The head is paler than in that species, and the marking of forewings different.

Queensland: National Park (3,500 feet), in December; one specimen.

Gen. Leurozancla, nov.

λευροξαγκλος, with smooth sickles.

Tongue present. Palpi long, slender, smooth-scaled; second joint exceeding base of antennae, only slightly thickened; terminal joint longer than second, very slender, acute. Antennae with basal joint long and somewhat thickened towards apex, without pecten; in male simple. Forewings broadly lanceolate; 2 from ⅝ widely separate from 3, which is from near angle, 7 and 8 stalked, 7 to costa. Hindwings ovate-lanceolate; 2 from near angle, 3 and 4 stalked, 5, 6, 7, separate, equidistant, parallel.

Allied to *Phthorimaea*, but with different palpi.

Leurozancla humilis, n. sp.

humilis, humble, insignificant.

♂, 20 mm. Head, palpi, and thorax dark fuscous. Antennae ochreous-whitish; basal joint fuscous on dorsum. Abdomen fuscous; tuft pale ochreous. Legs fuscous with obscure whitish rings. Forewings broadly lanceolate, apex obtusely pointed; fuscous; an obscure darker discal dot at ⅝; cilia ochreous-grey-whitish, on apex fuscous. Hindwings ovate-lanceolate, termen slightly sinuate; pale grey, towards base whitish; cilia 1, ochreous-whitish, on apex and costa tinged with grey.

Queensland: National Park (3,000 feet), in November; one specimen.

Gen. Tanycyttara, nov.

τανυκυτταρος, long-celled.

Tongue present. Palpi moderately long, recurved ascending, slender, smooth; second joint not reaching base of antennae; terminal joint ⅓. Antennae about ¾; without pecten; in male simple. Forewings with 2 and 3 stalked from angle, connate with 4, 6 to apex, 7 and 8 stalked, 7 to costa. Hindwings with cell very long (¾), 3 and 4 separate, 5 curved from below middle, 6 and 7 connate, 12 anastomosing at a point with cell at ⅓.

Tanycyttara xanthomochla, n. sp.

ξανθομοχλος, yellow-barred.

♂, 15 mm. Head and thorax brassy-fuscous. Palpi and antennae fuscous. Abdomen grey. Legs pale fuscous; posterior pair grey-whitish. Forewings narrow, costa slightly arched, apex rounded, termen very oblique; pale yellow; dorsal area suffused with fuscous; a fuscous streak from base along fold to tornus; a fuscous costal streak from base to middle, its apex connected by an oblique streak with a dark fuscous V-shaped mark resting on tornus; a broad dark fuscous marginal line on posterior ¼ of costa and tornus; cilia dark fuscous, on costa and apex pale yellow. Hindwings elongate-ovate, termen not sinuate; pale grey; cilia ½, pale grey.

Queensland: Crow's Nest, near Toowoomba, in September; one specimen.

Hemiarcha metableta, n. sp.

μεταβλητος, variable.

♂, 18 mm. Head fuscous; sides of crown and face ochreous-whitish. Palpi dark fuscous; apex and inner surface of second joint ochreous-whitish. Antennae grey. Thorax fuscous; tegulae whitish-ochreous. Abdomen grey; tuft ochreous-whitish. Legs fuscous with whitish rings; posterior pair mostly whitish. Forewings posteriorly dilated, costa rather strongly arched, apex pointed, termen obliquely rounded; whitish-ochreous suffused with grey and sprinkled with fuscous; a pale ochreous costal streak throughout, broader towards base; blackish costal dots at and near base, connected on costal edge; fuscous dots at base and in disc beneath costal streak at ¼, ⅓, and beyond middle, a plical dot between and beneath the first two; a fuscous line on termen and fuscous dots on apical ⅔ of costa; cilia fuscous-grey, with a postmedian ochreous-whitish line. Hindwings 1½, termen scarcely sinuate; pale grey becoming whitish towards base; cilia whitish with a pale grey basal line.

A second male example differs as follows:—Head and tegulae ochreous-brown. Forewings ochreous-brown with less grey suffusion; costal streak undefined; terminal line preceded by a darker line, between them four whitish-ochreous spots; plical dot large and connected with second discal dot. Hindwings and cilia pale grey. The two specimens are so different that I would not have referred them to one species, if I had not taken both at the same place and nearly at the same date.

Queensland: National Park (2,500 feet), in open forest in November; two specimens.

Hemiarcha basipercna, n. sp.

βασιπερκνος, dark at the base.

♂, 20 mm. Head brown-whitish. Palpi with second joint reaching base of antennae, terminal joint ⅓, stout; fuscous. Antennae fuscous. Thorax fuscous; tegulae paler. Abdomen fuscous. Legs fuscous with whitish rings. Fore-

wings moderate, costa almost straight, apex rounded, termen rounded, slightly oblique; pale brownish densely sprinkled with fuscous, more so in terminal area; a dark fuscous basal fascia; stigmata fuscous, first discal at ⅓, obscure, plical before it, second discal before ⅔, more distinct; cilia pale fuscous. Hindwings 1½, termen not sinuate; whitish; cilia whitish.

Queensland: Rockhampton, in October; one specimen.

Gen. **Lophozancla**, nov.

λοφοζαγκλος, with tufted sickles.

Tongue present. Palpi very long, ascending, recurved; second joint long, thickened with appressed scales; terminal joint as long as second, moderately stout, acute, with a tuft of scales on posterior surface extending from middle to near apex. Antennae in male simple. Posterior tibiae with long hairs on dorsum; inner spurs twice as long as outer. Forewings with all veins present, 2 and 3 stalked, 7 and 8 stalked, 7 to costa. Hindwings broader than forewings; all veins present, 3 and 4 connate, 5 approximated at origin, 6 and 7 widely separate gradually diverging.

Lophozancla stenochorda, n. sp.

στενοχορδος, narrowly streaked.

♂, ♀, 19-21 mm. Head brown-whitish. Palpi brown-whitish sprinkled with fuscous. Antennae brown-whitish. Thorax brown-whitish; lateral streaks and tegulae fuscous-brown. Abdomen whitish-grey; tuft whitish-ochreous. Legs ochreous-whitish sprinkled, except posterior pair, with fuscous; anterior pair except coxae fuscous. Forewings suboblong, costa gently arched, apex rounded, termen obliquely rounded; brown-whitish sprinkled and suffused with fuscous-brown; fuscous dots on costa at base, ⅙, middle, and three or four between this and apex; a narrow fuscous-brown bar from base along fold to ⅔; two suffused fuscous-brown spots beneath costa beyond middle, and a third at apex, these may be confluent; cilia brown-whitish, towards tornus with a fuscous median line, on apex fuscous. Hindwings with termen slightly sinuate; pale grey; cilia whitish with a fuscous median line not extending to tornus.

Queensland: National Park (3,000 feet), in December and January; four specimens.

Gen. **Oncerozancla**, nov.

ὀγκεροζαγκλος, with swollen sickles.

Tongue present. Palpi long, recurved; second joint exceeding base of antennae, thickened with appressed scales, slightly rough anteriorly; terminal joint over ½, laterally compressed, swollen anteroposteriorly so as to be as broad as second joint, anterior surface rough towards apex, which is obtusely pointed. Antennae without pecten. Forewings with 2 and 3 stalked, 7 and 8 stalked, 7 to costa. Hindwings 2, subquadrate; 3 and 4 connate, 5 approximated to 4 at origin, 6 and 7 widely separate.

This and the preceding genus are derivatives of *Protolechia.*

Oncerozancla euopa, n. sp.

εὐωπος, good-looking.

♀, 24 mm. Head ochreous-whitish; sides of face fuscous. Palpi dark fuscous; apex and inner surface of second joint, and terminal joint except apex, ochreous-whitish. Antennae grey becoming ochreous-whitish towards base. Thorax ochreous-whitish with some fuscous and brownish scales towards anterior margin. Abdomen whitish-ochreous; tuft except apex dark fuscous.

Legs ochreous-whitish irrorated, and tibiae banded with dark fuscous; anterior pair wholly dark fuscous except for narrow tibial and tarsal whitish rings. Forewings narrow, elongate, posteriorly slightly dilated, costa slightly arched, apex rounded-rectangular, termen obliquely rounded; ochreous-whitish largely suffused with brown, which forms a costal streak from base to ⅜, a large suffused postmedian blotch, and a slighter dorsal suffusion; five dark fuscous costal dots, the first two elongate; a subcostal mark in disc below the first; a large quadrangular spot in disc at ½, and another triangular at apex, fuscous; an interrupted whitish terminal line; a fuscous dorsal mark at ⅓, followed by dots before and on tornus; cilia grey with an imperfect fuscous median line. Hindwings whitish-ochreous; a large fuscous apical blotch produced along termen; cilia whitish-ochreous, a fuscous median line not reaching tornus.

Queensland: National Park (3,000 feet), in November; one specimen.

Protolechia trichroma, n. sp.

τριχρωμος, three-coloured.

♀, 15 mm. Head and thorax reddish. Palpi with terminal joint as long as second; whitish-ochreous, external surface of second and anterior edge of terminal joint fuscous. Antennae pale reddish annulated with blackish. Abdomen fuscous; underside pale ochreous. Legs fuscous with pale ochreous rings; posterior pair wholly pale ochreous. Forewings elongate, suboblong, costa rather strongly arched, apex rectangular, termen, nearly straight, not oblique; 2 and 3 stalked; reddish with some tendency to darker red streaks on veins; a whitish terminal line edged anteriorly and posteriorly with fuscous; cilia reddish. Hindwings 1¼; pale yellow; apical half grey; cilia grey, on tornus and dorsum pale yellow.

Queensland: National Park (3,000 feet), in March; one specimen.

Protolechia polioxysta, n. sp.

πολιοξυστος, polished grey.

♀, 18 mm. Head and thorax grey. Palpi with second joint much exceeding base of antennae, terminal joint ⅗, slender; fuscous, apex of second joint, base and extreme apex of terminal joint, whitish. Antennae dark grey. Abdomen grey. Legs fuscous; posterior tibiae mostly whitish. Forewings narrow, costa slightly arched, apex subrectangular, termen slightly rounded, scarcely oblique; 2 and 3 stalked; pale shining grey with fuscous irroration and markings; costal edge whitish, beyond middle ochreous-tinged; a dark fuscous dot on base of costa; stigmata indistinct, first discal at ¼, plical beyond it, second discal at ⅔; several other dots irregularly distributed; a subterminal series of dots; cilia grey-whitish with a dark grey antemedian line. Hindwings over 1, termen not sinuate; whitish becoming grey towards apex; whitish with a grey antemedian line.

Queensland: Springbrook (3,000 feet), Macpherson Range, in November; one specimen.

Protolechia tyroessa, n. sp.

τυροεις, cheese-coloured.

♂, 18 mm. Head and thorax ochreous-orange. (Palpi missing.) Antennae ochreous-orange with fuscous annulations. Abdomen grey. Legs fuscous; posterior pair whitish-ochreous. Forewings with costa gently arched, apex rounded, termen very obliquely rounded; 2 and 3 stalked; ochreous-orange with sparse dark fuscous irroration, mostly in terminal third, and markings; a broad outwardly oblique mark at ⅓ representing conjoined first discal and plical, second discal about ⅔; a costal dot at ⅙, another at ⅔, and four smaller between this and

apex; a fine interrupted terminal line; cilia ochreous. Hindwings 1½, termen not sinuate; grey, paler towards base; cilia grey, apices whitish.

Queensland: National Park (3,500 feet), in December; one specimen.

Protolechia neurosticha, n. sp.

νευροστιχος, with lines on nerves.

♂, 23 mm. Head and thorax brown. Palpi with second joint exceeding base of antennae, terminal joint ⅔; pale brownish, sprinkled with fuscous. Antennae brown. Abdomen brownish. Legs fuscous; posterior pair brown-whitish. Forewings elongate-oblong, costa gently arched, apex rectangular, termen nearly straight, slightly oblique; brown; cell and all veins outlined by pale streaks; two obscure fuscous dots at posterior angles of cell; cilia brown with two fuscous lines. Hindwings 1½, termen very sinuate; pale grey; cilia whitish with two grey lines.

Queensland: Brisbane; one specimen.

Protolechia ochrobathra, n. sp.

ὠχροβαθρος, pale at the base.

♀, 20 mm. Head grey-brown. Palpi with second joint exceeding base of antennae, terminal joint ⅗, stout; grey, apex of second joint whitish, terminal joint dark fuscous. Antennae dark fuscous. Thorax pale brownish with a large central dark fuscous spot. Abdomen grey. Legs fuscous with whitish rings. Forewings with costa moderately arched, apex rounded-rectangular, termen slightly rounded, slightly oblique; 2 and 3 stalked; brown mostly suffused with dark fuscous; a pale brownish basal area bounded by a straight line from ¼ costa to near base of dorsum, containing two fuscous costal dots; first discal and plical lost in dark fuscous suffusion, second discal slightly beyond middle, oval, transverse, whitish with fuscous centre; apical half of costa with alternate dark and pale bars; tornal area less suffused and more brownish; cilia brownish with two faint fuscous lines. Hindwings 1½, termen not sinuate; grey; cilia grey.

Queensland: Bunya Mountains (3,500 feet), in February; one specimen.

Protolechia obscura, n. sp.

obcurus, dark.

♂, ♀, 22-24 mm. Head, antennae, thorax, and abdomen fuscous. Palpi stout, terminal joint ¾, slender; fuscous, extreme apex of second joint whitish. Legs dark fuscous with whitish-ochreous rings; posterior pair whitish-ochreous. Forewings slightly dilated, costa gently arched, apex subrectangular, termen straight, slightly oblique; 2 and 3 stalked; fuscous; markings and some sparse irroration dark fuscous; five discal dots at ⅓, on fold beyond this, at ⅔, and immediately below this; the three posterior dots circular, pale centred; a series of minute costal dots; a subterminal series of dots near margin; cilia fuscous, apices paler. Hindwings 1½; grey; cilia grey.

Recognisable by the comparatively large size, uniform fuscous colouring, and ring-like posterior costal dots.

Queensland: National Park (2-2,500 feet), in December and January; four specimens.

Protolechia euprepta, n. sp.

εὐπρεπτος, conspicuous.

♂, 18 mm. Head grey. Palpi with second joint long, thickened with smooth appressed scales, terminal joint ⅗; fuscous, terminal joint whitish except anterior edge. Antennae fuscous; in male simple. Thorax white with a broad central

fuscous stripe. Abdomen ochreous-whitish. Legs fuscous; posterior pair ochreous-whitish. Forewings suboblong, costa strongly and evenly arched, apex rounded, termen obliquely rounded; 2 and 3 stalked; white; markings fuscous; four costal dots, sub-basal, at $\frac{1}{6}$, middle, and $\frac{3}{4}$; a broad streak on dorsum from near base to beyond middle; a large oval outwardly oblique spot in disc before middle, its lower and outer end confluent with dorsal streak; a large tornal blotch, connected with costa at $\frac{5}{6}$; a suffused spot on midtermen; a blackish terminal line; cilia grey, on costa whitish-ochreous. Hindwings broader than forewings, termen scarcely sinuate; whitish-ochreous; a large pale fuscous apical blotch; cilia whitish-ochreous, on apical blotch bases grey.

One of the *chiradia* group, but very distinct.

Queensland: National Park (3,000 feet), in January; one specimen.

Protolechia emmeles, n. sp.

ἐμμελης, elegant, harmonious.

♂, 14-16 mm. Head whitish-brown. Palpi stout; terminal joint $\frac{3}{4}$; fuscous sprinkled with whitish-brown, apices of second and terminal joints and base of terminal joint whitish-brown. Antennae fuscous. Thorax brown. Abdomen whitish-grey. Legs dark fuscous partly suffused and tarsi annulated with whitish-brown; posterior pair mostly whitish-brown. Forewings narrow, suboblong, not dilated, costa slightly arched, apex rounded-rectangular, termen not oblique, rounded beneath; 2 and 3 stalked; pale brown partly suffused with darker brown; dark fuscous costal dots at base and $\frac{1}{6}$, and on dorsum at $\frac{1}{6}$ preceded by a sub-dorsal dot; five oblique fuscous marks on costa from $\frac{1}{3}$ to apex their apices running into a subcostal fuscous suffusion, which is cut by an oblique white line, partly fuscous in centre from $\frac{2}{3}$ costa to middle of disc; a short blackish streak from apex separated from subcostal suffusion by a white dot; an interrupted white terminal line doubly edged with fuscous; cilia brown, apices paler, with a fine fuscous median line. Hindwings $1\frac{1}{4}$; grey-whitish; cila whitish with a sub-basal grey line.

Queensland: National Park (3,000 feet), in November, January, and March. New South Wales: Lismore, in October. Four specimens.

Protolechia arenaria, n. sp.

arenarius, sand-coloured.

♂, 17-18 mm. Head brown or brown-whitish. Palpi fuscous; apex of second joint, base and extreme apex of terminal joint, whitish. Antennae grey. Thorax brown or brown-whitish; if the former, bases of patagia brown-whitish; extreme basal edge of patagia dark fuscous. Abdomen whitish-grey tuft whitish-ochreous. Legs fuscous with whitish ochreous rings; posterior pair whitish-ochreous. Forewings suboblong, costa strongly arched, apex round-pointed, termen obliquely rounded; 2 and 3 stalked; brown or brown-whitish; costa broadly and suffusedly whitish from base to beyond middle; basal $\frac{1}{6}$ of costal edge dark fuscous; fuscous costal dots at $\frac{1}{6}$, middle, and four between this and apex; stigmata fuscous, first discal at $\frac{1}{3}$, plical beyond it, second discal at $\frac{2}{3}$, and a dot beneath it, both within a transverse whitish suffusion; a dot between and above discals; a narrow fuscous apical suffusion containing a series of pale marginal dots; cilia pale brownish with a fuscous median line. Hindwings broad, termen not sinuate; whitish-ochreous; extreme apex pale fuscous; cilia whitish, bases grey.

Nearest *P. selenia* Meyr.

Queensland: National Park (3,000 feet), in October and November; three specimens.

Crocanthes venustula, n. sp.

venustulus, exquisite.

♂, 10 mm. Head and thorax whitish-yellow. Palpi in male with second joint short, reaching middle of face, terminal joint 3, recurved, expanded from before middle to apex, laterally compressed; whitish. Antennae whitish, towards apex grey. Abdomen pale grey. Legs ochreous-whitish; anterior pair and apices of middle tibiae fuscous. Forewings narrow, costa slightly arched, apex rectangular, termen nearly straight, slightly oblique; orange-yellow, two blackish transverse lines at $\frac{1}{3}$ and $\frac{2}{3}$; a minute subapical blackish dot; cilia orange-yellow. Hindwings whitish-yellow; a fuscous discal dot and a faint transverse line from tornus; cilia yellow.

North Queensland: Cape York, in June; one specimen received from Mr. W. B. Barnard.

Crocanthes thiomorpha, n. sp.

θειομορφος, sulphur-yellow.

♂, ♀, 15-17 mm. Head and thorax whitish. Palpi with second joint exceeding base of antennae, terminal joint in male $^1/_{10}$, in female $\frac{2}{3}$; whitish, terminal joint pale fuscous. Antennae grey. Abdomen ochreous-fuscous. Legs whitish-ochreous; anterior pair pale fuscous; apices of middle and posterior tibiae fuscous. Forewings narrow, costa straight, apex obtusely pointed, termen very obliquely rounded; 10 separate; pale yellow; sometimes a small fuscous basal fascia; terminal area, bounded by a straight line from $\frac{2}{3}$ costa to mid-dorsum, pale fuscous, but this may be more or less suffused with pale yellow on costa and before termen; cilia grey, bases yellowish. Hindwings and cilia pale grey.

North Queensland: Eungella, in October; three specimens.

Family HELIODINIDAE.

Stathmopoda xanthocrana, n. sp.

ξανθοκρανος, with yellow head.

♀, 10 mm. Head yellow; fillet and face paler and glossy. Palpi fuscous; internal surface whitish. Antennae fuscous. Thorax and abdomen fuscous. Legs fuscous; ventral surfaces partly whitish. Forewings lanceolate; yellow; markings fuscous; a small suffused basal patch; a broadly suffused median fascia; apical third of wing fuscous, leaving only a narrow yellow band beyond median fascia; cilia fuscous. Hindwings linear-lanceolate; fuscous; cilia 8, fuscous.

Queensland: National Park (3,000 feet), in March; one specimen.

Family CARPOSINIDAE.

Gen. Epicopistis, nov.

ἐπικοπιστις, cut short.

Palpi comparatively short, porrect or subascending, smooth-scaled, cylindrical; terminal joint very short. Antennae of male with long ciliations. Posterior tibiae clothed with long hairs. Forewings with all veins present and separate, 2, 3, 4, approximated from angle, 7 to termen. Hindwings without cubital pecten; 3 and 4 stalked, 5 absent, 6 obsolete but represented by a membranous fold well separate from and nearly parallel to 7.

Near *Paramorpha* Meyr., but with different palpi.

Epicopistis pleurospila, n. sp.

πλευροσπιλος, with costal spot.

♂, 18 mm. Head and thorax white. Palpi $1\frac{1}{2}$; fuscous, apex white. Antennae grey; basal joint white; ciliations in male 3. Abdomen grey; male genitalia with two pairs of long tufts, dorsal and lateral. Legs fuscous; posterior pair whitish. Forewings narrow, suboblong, costa gently arched, apex round-pointed, termen straight, oblique; white; markings dark fuscous; a triangular spot on base of costa; a costal dot at $\frac{1}{3}$; a rather large subtriangular spot on $\frac{2}{3}$ costa, pale fuscous containing three darker costal dots and a darker apical portiom; two costal dots between this and apex; a very slender dentate subterminal line; a terminal series of dots; cilia white.

Queensland: National Park (3,000 feet), in March; two specimens received from Mr. W. B. Barnard, who has the type.

Family TINEIDAE.

Gen. **Gongylodes**, nov.

γογγυλωδης, rounded.

Head and face rough-haired. Tongue and maxillary palpi absent. Palpi ascending, exceeding vertex; second joint long, shortly rough-haired; terminal joint minute. Antennae about $\frac{3}{4}$. Posterior tibiae with long hairs on dorsum. Forewings with all veins present and separate, 2 from $\frac{3}{4}$, 3 from $\frac{7}{8}$, 7 to costa. Hindwings with cell long ($\frac{2}{3}$), 2 from $\frac{3}{4}$, 3, 4, 5, 6, and 7 separate, parallel.

Gongylodes centroscia, n. sp.

κεντροσκιος, with central shade.

♀, 17 mm. Head and thorax brown. Palpi $3\frac{1}{2}$; brownish. Antennae pale grey, darker towards base. Abdomen grey. Legs ochreous-whitish; anterior pair fuscous. Forewings rather narrow, suboval, costa strongly and uniformly arched, apex pointed, termen very oblique, continuous with dorsum; whitish-ochreous; an ill-defined basal patch; a suffused brown median streak from this, expanding in disc, and broadly suffused over terminal area; cilia whitish-ochreous, on apex brown. Hindwings elongate, termen gently rounded; grey, cilia pale grey.

Queensland: National Park, in March; one specimen received from Mr. W. B. Barnard.

Narycia commatica, n. sp.

κομματικος, stamped, impressed.

♂, 30-33 mm.; ♀, 42 mm. Head, thorax, and abdomen dark brown. Palpi 1; dark brown. Antennae dark brown; in male dentate, ciliations 1. Legs dark brown; anterior and middle tarsi dark fuscous. Forewings suboval, costa strongly arched, at base very strongly, apex round-pointed, termen slightly rounded, oblique; 7 and 8 stalked; dark brown finely reticulated with fuscous; costa with fine short fuscous strigulae; a somewhat darker basal patch; sometimes a darker fascia, its anterior edge from $\frac{1}{2}$ costa to mid-dorsum, posterior edge undefined, commonly this is reduced to ill-defined costal and dorsal dark spots; cilia brownish. Hindwings with termen gently rounded; pale grey reticulated with darker; cilia pale grey.

In wing-shape this resembles *N. euryptera* Meyr, but with very different colouring.

Queensland: National Park (3-3,500 feet), in March; a series taken, but including only one female.

Gen. **Dinocrana**, nov.

δινοκρανος, with rounded head.

Head shortly rough-scaled; face projecting in a strong rounded prominence between eyes. Tongue and maxillary palpi absent. Labial palpi moderate, porrect; second joint shortly rough-haired beneath towards apex; terminal joint short, acute. Antennae about $\frac{1}{2}$; in male moderately and evenly ciliated. Posterior tibiae smooth. Forewings with all veins present and separate, 2 from near angle, 7 to termen. Hindwings with cell about $\frac{2}{5}$, all veins present and separate, 4, 5, 6, 7, equidistant, parallel.

One of the *Narycia-Ardiosteres* group, but not closely related to either.

Dinocrana chrysomitra, n. sp.

χρυσομιτρος, with golden girdle.

♂, 14 mm. Head, thorax, and abdomen fuscous. Palpi fuscous, towards base whitish-ochreous. Antennae fuscous; ciliations in male 1. Legs whitish-ochreous partly suffused with fuscous leaving pale tibial and tarsal rings. Forewings oval, costa rather strongly arched, apex rounded, termen very obliquely rounded; fuscous; an antemedian subtriangular yellow fascia, narrow on costa at $\frac{1}{3}$, anterior edge inwardly oblique to dorsum near base, posterior edge transverse; cilia fuscous, a pale yellow dot opposite midtermen. Hindwings elongate-ovate, apex rounded; fuscous; cilia fuscous.

Queensland: National Park (3,500 feet), in March; one specimen.

Gen. **Baeophylla**, nov.

βαιοφυλλος, slight-winged.

Head and face hairy. Maxillary palpi long, folded. Labial palpi rather long, smooth, slender, drooping. Antennae about 1. Posterior tibiae with a few long hairs from basal half of dorsum, otherwise smooth. Forewings with 4 absent, 7 and 8 by a common stalk from 6, 7 to costa. Hindwings almost linear; 2, 3, and 6 absent, 4 and 5 stalked.

Probably a development of *Tinea*.

Baeophylla eupasta, n. sp.

εὐπαστος, well sprinkled.

♀, 8-9 mm. Head ochreous-fuscous; face whitish. Thorax pale ochreous with some fuscous irroration. Antennae whitish. Abdomen grey. Legs fuscous with whitish rings; posterior pair whitish. Forewings very narrow, costa gently arched, apex pointed; ochreous-whitish partly suffused with ochreous-brown with a few dark fuscous scales; costa ochreous-brown becoming fuscous towards base, interrupted by whitish-ochreous dots; a similar median series of pale and dark dots, and a dorsal series, the last continued along termen to an apical whitish dot; cilia ochreous with a subapical dark fuscous line, becoming uniformly grey on lower half of termen, tornus, and dorsum. Hindwings almost linear, grey; cilia 20, grey.

Queensland: National Park (25-500 feet), in December and January; two specimens.

Gen. **Ptyssoptera**, nov.

πτυσσοπτερος, with crumpled wing.

Head and face rough-haired. Maxillary palpi long, folded. Labial palpi moderate, drooping, smooth-scaled; second joint with a pencil of short divergent

hairs from external surface near apex. Antennae less than $\frac{1}{2}$; in female slender; in male much thickened almost to apex. Posterior tibiae clothed in long, dense hairs. Forewings with all veins present and separate, 7 to costa. Hindwings elongate-ovate; 5 and 6 stalked; in male with disc crumpled beneath, on upper surface with a very strong ridge of long hairs from near dorsum in basal third, bent over costally, and partly concealing a subcostal ridge of shorter hairs.

Type *Tinea phaeochrysa* Turn. (These Proceedings, 1926, p. 135.) I have taken two examples of the male in the National Park (3,000 feet), in November.

Tinea mesoporphyra, n. sp.

μεσοπορφυρος, purple in the middle.

♀, 10 mm. Head, thorax, abdomen, and legs brownish-fuscous. Antennae about 1; pale ochreous annulated with fuscous. Forewings rather narrow, costa nearly straight, apex pointed; ochreous-fuscous; the whole median area suffused with purple-fuscous, undefined, but leaving moderate basal and apical areas free; cilia grey sprinkled with fuscous. Hindwings lanceolate; grey; cilia 2, grey.

Queensland: National Park (3,500 feet), in March; one specimen.

Tinea sulfurata, n. sp.

sulfuratus, sulphur-yellow.

♀, 24 mm. Head yellow. Palpi 4; fuscous, extreme apex yellowish. Antennae $\frac{2}{3}$ fuscous. Thorax fuscous; tegulae except bases yellow. Abdomen fuscous; tuft yellowish. Legs yellowish; anterior pair dark fuscous. Forewings elongate, narrow, suboval, costa moderately arched, apex pointed, termen straight, very oblique; all veins separate; yellow with fuscous markings more or less developed; a fuscous costal streak from base to beyond middle; a darker dot on fold beneath this, connected with dorsum by some fuscous suffusion; a rather broad transverse mark in disc at $\frac{2}{3}$; terminal area beyond this more or less suffused with fuscous; cilia yellow, bases sometimes fuscous. Hindwings with termen gently rounded; grey; cilia grey, partly yellowish-tinged.

Queensland: National Park (3,000 feet), in March; two specimens received from Mr. W. B. Barnard, who has the type.

NOTES ON THE FLORA OF SOUTH AUSTRALIA.

No. 2.

(With Descriptions of New Species.)

By Ernest H. Ising.

[Read October 12, 1933.]

Marsiliaceae.

Marsilia hirsuta R. Br. In a number of specimens collected in the Far North, Nos. 2,430, 2,431, 2,432, 2,433, 2,788, and 2,789, further details can now be given to aid in the identification of this difficult group. Leaflets from obovate to cuneate, 2-12 mm. long hairy when young and often becoming glabrous with age, usually woolly at the base; sporocarps 2-7 mm. long and 2½-5 mm. wide, usually swollen (but not globular), regularly transversely corrugated and covered with dense appressed hairs, stalks 1-5 mm. long, apparently rarely sessile.

Scheuchzeriaceae.

Triglochin elongata, n. sp. Annua, erecta, 6-10 cm. alta; folia filiformia, scapis aequilonga vel longiora, vaginâ membraneâ, ligulis capillaribus; racemi 2 cm. longi, 8-13-flori; fructus 4-5½ mm. longus, oblongus, apice angustatus, base 1½ mm. latus; calcaria basilaria conspicua, 1½-2 mm. longa, sursum curvata, duo breviora, 1 mm. longa, a basi cujusque carpelli inferius producta et inter se laminâ membraneâ conjuncta; pedicelli 2-3½ mm. longi, divergentes (figs. 6-9, p. 184).

Erect annual, 6-10 cm. high; leaves filiform, as long or longer than the scapes, base with membranous sheaths and two hairlike ligules; scapes bearing 8-13 racemose flowers, raceme 2 cm. long; fruits 4-5½ mm. long, oblong and contracted at the summit, 1½ mm. wide at the base, spurs on the base of 3 carpels, conspicuous 1½-2 mm. long, curved upwards, also 2 spurs each 1 mm. long are produced from the base of and extended below the carpels, and are joined by a membranous plate; pedicels 2-3½ mm. long, divergent.

Differs from all other species in having extra basal spurs produced below the carpels with a connecting plate between them.

Central Australia, Coglin Creek, August 26, 1931, No. 2,409. Type in author's collection.

A specimen in the Tate Herbarium, Adelaide University, from near Mount Squires, collected by R. Helms, August 26, 1891, on the Elder Exploring Expedition, is labelled *T. calcitrapa*, but belongs to the new species.

Liliaceae.

Bulbine semibarbata (R. Br.) Haw. var. *depilata* J. M. Black. Two specimens were collected at Callana, August 21, 1931, which is in the same district from which the type of the variety came. I can confirm Black's observations[1] on this new variety with regard to the filaments being scantily hairy and in the number and disposition of the seeds. My specimen, No. 2,394, has only one flower open but a number of ripe capsules. Three of the anthers are beardless, and the three longer ones have very few and very short hairs, which are easily observed by the aid of a hand lens. Three ripe capsules were examined, and the rule is

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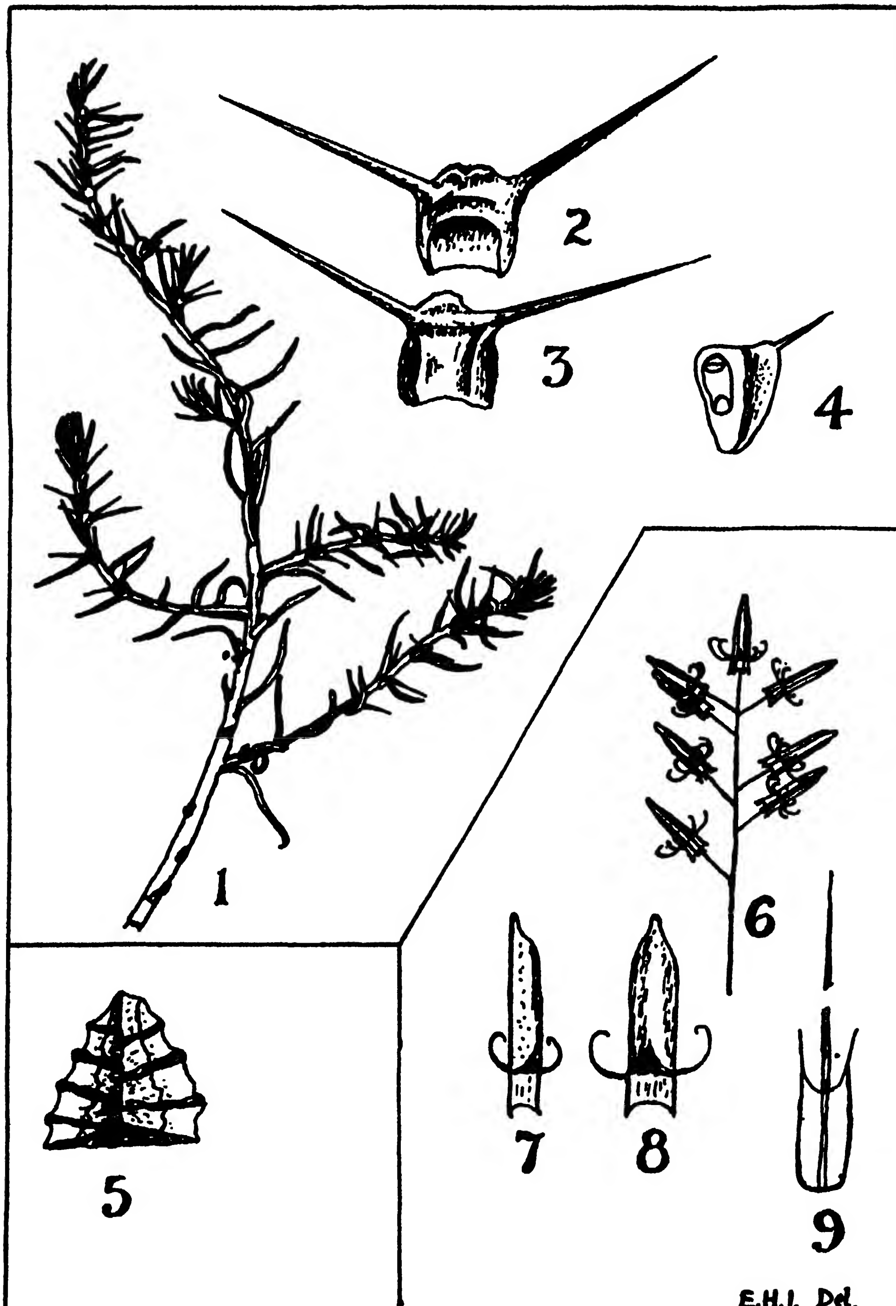
(1) These Trans. vol. lvi. (1932), 39.



DESCRIPTION OF FIGURES.

Fig. 1. *Bassia Andersonii*, n. sp. Fruiting branch, nat. size. Fig. 2. Fruit of same showing posterior face, x 5. Fig. 3. Fruit of same showing anterior face, x 5. Fig. 4. Showing vertical section of fruit with vertical seed. x 5.

Fig. 5. *Bulbine semibarbata* var. *depilata*. Seed showing transverse ridges, x 7.

Fig. 6. *Triglochin elongata*, n. sp. Part of scape showing raceme, x 2. Fig, 7. Side view of one carpel, x 5. Fig. 8. Back (anterior) view of one carpel, x 5. Fig. 9. Base of leaf showing sheath and ligules, x 2.

two superposed seeds in each cell; sometimes a cell has only one seed developed, in which case it is larger than usual and tapering both ends. The seeds are triangular in shape (fig. 5, p. 184), 3 mm. long, the anterior face is flat while the other faces form a rugose pyramid, the transverse ridges of which are dark and prominent and stand out in contrast to the lighter grooves between. The flowers are yellowish. Further research seems necessary to determine the ovarian character in this genus.

LORANTHACEAE.

Loranthus Maidenii Blakely. First record for *Central Australia,* Horse Shoe Bend, August 24, 1931, No. 2,434, on *Acacia tetragonophylla.*

L. quandang Lindl. var. *Bancroftii* Bail. Abminga, August 27, 1931, No. 2.403, on *Acacia Cambagei.* This record now takes the known range some hundred of miles further north; in fact, it extends it almost to the border of Central Australia.

L. Murrayi F. v. M. *et* Tate. Pedirka, August 29, 1932, No. 2,804, on *Acacia cyperophylla.*

CHENOPODIACEAE.

Bassia Andersonii, n. sp. Fruticulus glaber, 20-30 cm. altus; folia sessilia, obtusa, 6-18 mm. longa 1 mm. lata, base anguste alata, in axillis barbata: flores solitarii, axillares; perianthium fructiferum oblongum, subcomplanatum, 3 mm. longum, 1½ mm. latum, limbo juventute erecto et tomentoso, maturitate saepe procurvato et glabro, dimidio longitudinis ad ramulum affixo; spinae saepius 4, 2 divergentes, 5-7 mm. longae, glabrae, patentes, tertia uncinata, 1½ mm. longa, quarta (dum adsit) minuta, ambae inferius collocatae; semen verticale (figs. 1, 2, 3. 4, p. 184).

An erect undershrub of 20 to 30 cm. in height, glabrous. Leaves 6 to 18 mm. long x 1 mm. wide, flat, glabrous (dried specimens are beset with numerous fine longitudinal ridges), point obtuse; sessile, base broad and expanded into narrow membranous wings, a tuft of hairs situated at the point of attachment. Flowers solitary, axillary. Fruiting perianth 3 mm. long x 1½ mm wide, oblong and somewhat flattened, usually 1 or 2 longitudinal ribs on anterior face; limb short, erect and tomentose when young, often curved forward and glabrous when mature; base oblique, areole attached by about half the length of the perianth and hollow; spines usually 4, two divergent and 5 to 7 mm. long straight and glabrous, spreading towards the horizontal, one hooked horizontal either turned in a clockwise or anti-clockwise direction 1½ mm. long, one (sometimes wanting) minute and situated at the base of the former; these two smaller spines are situated below either of the divergent ones; seed vertical.

The nearest affinity is with *B. divaricata* but differs in its shorter spines, erect limb, mode of attachment of fruits, ribbing of perianth and the caducous fruits. From *B. intricata* it differs in its stouter spines, mode of attachment of fruits, ribbed perianth, tapering base and caducous fruits.

Pedirka, No. 2,681, type in author's collection. Named in honour of Mr. R. H. Anderson, B.Sc. (Agr.), Botanical Assistant, Botanic Gardens, Sydney, who revised the genus Bassia in the Proc. Linn. Soc. N.S.W., vol. xlviii. (1923), 317. Collected August 22, 1931.

Specimen No. 2,686, collected at Abminga, is close to the type, and the only difference appears to be that the spines are shorter, the longest being only 4 mm. long, the two smallest spines are much less developed. Collected August 28, 1931.

Kochia tomentosa (Moq.) F. v. M. var. *platyphylla,* n. var. Differt a typo foliis oblanceolatis et tubo obconico; a var. *appressa* foliis oblanceolatis usque 9 mm. longis.

Differs from the type in the oblanceolate leaves and obconical tube; from var. *appressa* in the leaves oblanceolate and up to 9 mm. long.

The slender open nature of this shrub, with leaves unusually wide for a *Kochia,* give it a distinct aspect, but there does not appear to be justification for more than a varietal name, particularly as only one shrub of it was seen. Snake Gully, No. 2,839, September 1, 1932.

Kochia tomentosa (Moq.) F. v. M. var *appressa* (Benth.) J. M. Black. A specimen, No. 2,814, from Snake Gully, has fruits up to 13 mm. diameter and the conical tube sometimes only has one distinct rib with several faint ones or it may be rugose. This specimen also has an unbroken horizontal wing.

K. Georgei Diels. A specimen from Abminga, No. 2,821, has the horizontal wing of the fruit with a slit having the ends imbricate, the tube is longitudinally ribbed or rugose.

K. eriantha F. v. M. The drawing of this species in Mueller's Icon. Salsol. Pl., plate 57, gives the seed as horizontally placed. In a specimen, No. 2,824, from Pedirka, the seed is obliquely placed, although, at first sight, it appears to be horizontal. The seed is placed at an angle of about 60°, and the radicle is pointing downwards. I have not seen fruits with seeds in a vertical position as recorded by Black (Fl. S.A., p. 197). The soft lobes to the wing are not always regular as shown in the above plate, but are decidedly irregular in size and outline.

Amaranthaceae.

Trichinium helipteroides F. v. M. var. *minor* J. M. Black. Additional localities are:—*Central Australia,* Coglin Creek, No. 2,425, August 26, 1931; *South Australia,* Abminga, Nos. 2,413, 2,419, 2,435, August 28, 1931.

T. semilanatum Lindl. Additional localities for our Far North are:—Macumba, No. 2,438, September 2, 1931; Pedirka, No. 2,439, August 22, 1931; Abminga, No. 2,437, August 30, 1931.

Amaranthus Mitchellii Benth. var. *grandiflorus* J. M. Black. First record for *Central Australia,* Horse Shoe Bend, No. 2,453, August 23, 1931.

Aizoaceae.

Trianthema crystallina Vahl. var. *clavata* J. M. Black. First record for *Central Australia,* Horse Shoe Bend, No. 2,467, August 24, 1931.

Portulacaceae.

Calandrinia pumila F. v. M. New locality for our Far North; Abminga, August 27, 1931, Nos. 2,475 and 2,477.

Cruciferae.

Stenopetalum nutans F. v. M. New locality for our Far North; Abminga, August 27, 1931, No. 2,497.

Blennodia pterosperma J. M. Black. New records are:—*Central Australia,* Horse Shoe Bend, August 24, 1931, No. 2,503; Far North, Macumba, September 3, 1931, No. 2,504.

Lepidium papillosum F. v. M. Macumba, September 3, 1931, No. 2,494. The previous furthest north record was Flinders Range, so that the above locality extends its range by another 300 miles.

AUSTRALIAN FUNGI: NOTES AND DESCRIPTIONS.—No. 9

By J. Burton Cleland, M.D.

[Read October 12, 1933.]

534. *Amanita cinereo-annulosa*, n. sp.—Pileus 5 ad 8·2 cm., subplanus, interdum subumbonatus vel subumbilicatus, nitidus, interdum veli fragmentis membranaceis, cinereus vel pallidior. Lamellae ad stipem subattingentes, subconfertae, latae ad 1 cm., albae vel cremaceo-albae. Stipes 8·7-13·7 cm., crassus (1·5-2 cm.), subcavus, sub-bulbosus, radicatus, striatus, supra subcinereus, infra albidus et fibrillosus. Volva larga, vaginata. Sporae ellipticae, 8-10 × 6-7 μ. S.A.—Encounter Bay.

535. *Lepiota cervicolor*, n. sp.—Pileus ad 4 cm., usitate ad 2 cm., planus, subumbonatus, tomento fibrilloso deinde squamis fibrillosis vel floccosis, cervicoloratus vel "mikado brown," ad peripherem carneo-cinnamoneus. Lamellae non annectatae, cremacco-albae. Stipes substriatus, fibrillosus, albidus, supra subcarneus. Sporae ellipticae, 6·4-7 × 3·8 μ. S.A.—Adelaide.

536. *Hygrophorus fuligineo-squamosus*, n. sp.—Pileus 3·1-6·8 cm., irregulariter convexus et planus, subtiliter squamosus vel fibrilloso-floccosus, caryophyllo-brunneus vel cinereo-subniger. Lamellae adnato-arcuatae, adnexae vel fere subsinuatae, subconfertae, angusto-triangulares, subcrassae, glauco-cinereae. Stipes ad 5 cm., infra attenuatus, conico-radicatus, fibrillosus vel fibrilloso-squamulosus, fere araneo-fibrillis subnigris, subcinereo-albidus, fere punctis fuliginosis. Sporae ellipticae, obliquae, 7·5-9 × 4·5-5·5 μ. In terra. S.A.—Mount Lofty, Kinchina, MacDonnell Bay.

537. *Collybia tortipes*, n. sp.—Pileus 1·2-3·7 cm., convexus, subumbilicatus, fibrilloso-laceratus, subniger, luteo-brunneus vel caryophyllo-brunneus. Lamellae sinuatae, ventricosae, subdistantes, albae, in senectute luteo-brunneo-albidae. Stipes 3·1-4·4 cm., subtenuis, tortus, non-radicatus, subnitidus vel subfibrillosus, subcavus, cartilagineus, albidus. Sporae angustae, albae, 8-11 × 4-4·5 μ. In terra arenosa. S.A.—Willunga Hill, Summertown.

538. *C. penetrans*, n. sp.—Pileus 2·5-3·1 cm., e convexo irregulariter planus, interdum repandus, interdum subumbonatus vel subumbilicatus, innato-fibrillosus, interdum radiato-rugosus, russus vel ochraceo-fulvus vel aurantiaco-cinnamoneus. Lamellae subsinuato-adnexae, subconfertae, cinnamoneo-luteae, deinde ochraceo-fulvae. Stipes superans terram 1·8-3·1 cm., tenuis (4 cm.), cavus, pervelutinatus, "argus brown" et "Sudan brown," radice longa (5-7·5 cm.). Caro stibio-flava. Sporae obliquae, angusto-pyriformes, 7·5-8 × 4-4·5 μ. In terra arenosa. S.A.—Encounter Bay.

539. *C. percava*, n. sp.—Pileus 3·7-5 cm., perconvexus, deinde convexus, deinde irregulariter expansus, interdum umbonatus, "Mars brown" deinde russus vel subfulvus. Lamellae sinuato-adnexae, angustae (5 mm.), subconfertae, pallido- ochraceo-luteae. Stipes ad 5 cm., infra inflatus, supra attenuatus, nitidus, percavus, "Sayal brown" vel russus, supra pallidus. Sporae pyriformes, 5 × 3·7 μ. In terra. S.A.—National Park.

540. *C. elegans*, n. sp.—Pileus 1·8-3 cm., campanulato-convexus deinde perconvexus et obtuso-umbonatus, deinde subplanus, subrivulosus, cinnamoneo-rufus, fulvus vel aurantiaco-luteus, exsiccatus "burnt-sienna." Lamellae adnato-adnexae ad adnatae, confertae, angustae, cremaceae. Stipes 3·7-6·5 cm., tenuis

(2-5 mm.), aequalis, nitidus, cartilagineus, solidus, ad basim interdum inflatus, concoloratus. Sporae angustae, 9-11 × 4·5-5·5 μ. In terra inter folia et lignum cariosum. S.A.—National Park, Mount Lofty.

541. *C. fusca*, n. sp.—Pileus 3-9·3 cm., convexus, subumbonatus, fuscus vel fusco-niger. Lamellae sinuatae, vel interdum adnatae, ad 1 cm. latae, subconfertae, pallido-subcinereae. Stipes 3-9·3 cm. × 5-8 mm., supra farinaceus, infra subfibrillosus, aequalis, farctus, subcinereo-pallidus vel subfusco-pallidus. Sporae ovales, subirregulares, 7-9 ×4-5·5 μ. S.A.—Eagle-on-the-Hill, National Park.

542. *Mycena subnigra*, n. sp.—Pileus ad 1·8 cm. altus et latus, campanulatus ad conico-campanulatus, glaber, substriatus, subniger ad "Mummy brown." Lamellae adnatae vel sinuato-adnatae, dentibus subdecurrentibus, subconfertae, ventricosae, subcinereae. Stipes 5 cm. vel major, sursum subattenuatus, supra concoloratus, infra pallidus et perstrigosus. Sporae 7·5-9 × 4·5-5·5 μ. Plantae ad truncos caespitosae. S.A.—Mount Lofty, Caroline State Forest.

543. *M. eucalyptorum*, n. sp.—Pileus 2·5-3·1 cm., lato-conicus vel conico-convexus, deinde convexus et obtuso-umbonatus, glaber, ad marginem substriatus et pallidus, subnigro-cinereus. Lamellae sinuato-adnexae interdum ad collare, subconfertae, angustae, subcinereae. Stipes ad 6·2 cm., tenuis, cavus, ad basim substrigosus, supra pallidus, deinde pallido-brunneus, ad basim subnigro-cinereus. Sporae 9·3 × 5·5 μ. Plantae in truncis prostratis caespitosae. S.A.—Second Valley Forest Reserve, Mount Lofty, National Park, Baker's Gully.

544. *M. Cunninghamiana*, n. sp.—Pileus ad 4·3 cm., convexus, subumbonatus, irregulariter rugosus, flavo-avellaneus, ad apicem brunnior deinde subniger. Lamellae adnatae, subconfertae, subangustae, pallido-vinaceo-luteae. Stipes 7·5 cm., supra glaber, cavus, ad basim perstrigosus et "Verona brown," supra pallidior. Sporae 8-8·5 × 5·5 μ. Plantae in truncis caespitosae. S.A.—Mount Lofty.

545. *M. fusca*, n. sp.—Pileus 1·2-1·8 cm. vel maior, conico-campanulatus vel lato-conicus vel convexus, deinde umbone subacuta subplanus, striatus, ad marginem cinereus vel pallido-cinnamoneo-cinereus vel "wood brown," in medio fuscus vel fusco-subniger vel "bone brown," hygrophanus deinde pallido-brunneus. Lamellae dentibus subdecurrentibus adnatae, subconfertae, cinereo-pallidae. Stipes 3·7-5 cm., tenuis, subfragilis, glaber, cavus, infra pallido-olivaceo-brunneus vel vinaceo-luteus vel "bone brown," supra pallidior, ad basim substrigosus vel submyceliosus. Odor subnitrosus. Sporae 7·5-11 × 3·5-5 μ Plantae in terra humida vel in foliis putrescentibus solitariae. S.A.—Waterfall Gully, National Park.

546. *M. subcapillaris*, n. sp.—Pileus 3-5 mm., altus 2·5 mm., umbilicatus, sulcatus, albus ad pallido-brunneus. Lamellae adnatae, subdistantes, circa 14, cystidiis horridae, albae. Stipes 2·5-3 cm., pertenuis, subpellucido-albidus, crinibus dispersis, in matricem abrupte penetrans. Sporae subangustae, 7·5 × 3·7 μ. In virgis, frondibus mortuis, etc. S.A.—Mount Lofty.

547. *M. albido-fusca*, n. sp.—Pileus 10 mm., convexo-hemisphericus, umbonatus, substriatus, umbone albido fuscus. Lamellae dentibus decurrentibus adnatae, subdistantes, subcinereae. Stipes 5 cm., pertenuis, ad basim fibrillis paucis, infra brunneus, supra pallidus. Sporae ellipticae, 8 ×5·5 μ. Plantae foliis putrescentibus adhaerentes. S.A.—Mount Lofty.

548. *Omphalia paludicola*, n. sp.—Pileus ad 10 mm., campanulatus, deinde convexus, subumbilicatus, rugoso-striatus, subcinereo-carneo-luteus. Lamellae perdecurrentes, distantes, albae. Stipes 19 mm., tenuis, concoloratus. In palude. S.A.—Mount Lofty.

549. *O. olearis*, n. sp.—Plantae albae vel in pileo creamaceo-albae. Pileus 8 mm., conico-convexus, deinde convexus et interdum subumbonatus, glaber.

Lamellae decurrentes, confertae. Stipes ad 3 cm., undosus, glaber. Plantae ad bases olearům. S.A—Beaumont.

550. *Pleurotus malleeanus,* n. sp.—Pileus ad 11·2 cm., convexus, margine incurvato, glaber vel nodosus et irregularis, cinnamoneo-luteus. Lamellae decurrentes, confertae, 6 mm. latus, carneo-luteae. Stipes 3·1-10 cm., centralis vel excentricus vel lateralis, supra 2·5 cm. latus, aequalis vel deorsum attenuatus, durus, solidus, albus. Caro crassa vel 1·2 cm. Sporae elongatae, 8-10 $\times$ 4 μ. Ad bases mallee-truncorum senum. S.A.—Monarto South.

551. *Entoloma reticulata,* n. sp.—Pileus 2·5-5 cm., convexus, subumbilicatus, lineis concentricatis et interdum rimosis reticulatus vel adversum marginem portionibus irregularibus elevatis et fissuris pallidioribus, cinereus. Lamellae dentibus subdecurrentibus subsinuatae, confertae, angustae, cinereo-carneo-luteae. Stipes 1·8 cm., subtenuis, infra striatus, infarctus vel interdum cavus, particulis pallido-fumoso-cinereis, subter subniger. Caro tenuis, albida. Sporae subspherico-pyriformes, subangulatae, subcoloratae, 4·5-5·5 μ. Ad terram. S.A.—Mount Lofty.

552. *E. muscorum,* n. sp.—Pileus ad 3 cm., irregulariter convexus, subumbonatus, luteo-brunneus. Lamellae profundo-sinuato-adnexae, subconfertae, ventricosae, avellaneae. Stipes 3·7 cm., subtenuis, tortus, cavus, corneo-subcinereus. Caro corneo-subcinerea. Sporae irregulariter ellipticae, subcoloratae, 8-8·5 $\times$ 6·5 μ. Inter muscos. S.A.—Greenhill Road.

553. *E. serrata,* n. sp.—Pileus 2·5 cm., perconvexus, irregularis, glaber, albus, in centrum subluteus. Lamellae adnexae, paene disjunctae, subascendentes, confertae, angustae, marginibus serratis, subfusco-carneae. Stipes 3·1 cm. $\times$ 6 mm., aequalis, substriatus, solidus, subluteo-albidus. Sporae obliquae, 10-11 $\times$ 5 μ. In terra paludosa. S.A.—Mount Compass.

554.—*Clitopilus australiana,* n. sp.—Pileus 3 cm., convexus, umbilicatus, pallido-brunneus. Lamellae subdecurrentes, confertae, pallido-brunneae. Stipes 2·5 cm., fibrillosus, pallidus. Sporae pyriformes, subangulatae, subcoloratae, 6·5-7 $\times$ 5·5 μ. S.A.—National Park.

555. *Leptonia albida,* n. sp.—Pileus ad 1·8 cm., subirregulariter convexus, deinde planus vel subconcavus, subumbonatus, albus. Lamellae adnatae vel subsinuatae, subconfertae, albidae. Stipes 1·8 cm., tenuis, infra subattenuatus, infarctus vel subcavus, infra fuscus, supra albidus. Sporae subspericales, angulatae, subcoloratae, 6·5 $\times$ 3·2 μ, 4·8 μ. S.A.—Kinchina.

556. *L. macrospora,* n. sp.—Pileus ad 2·5 cm., convexus, irregulariter umbilicatus, margine crenato, pallido-subcarneo-brunneus. Lamellae adnatae vel adnato-decurrentes, subconfertae, subtriangulares, pallido-salmoneo-carneae. Stipes ad 2·5 cm., tenuis vel subcrassus, subsericeus, interdum torsus, subcavus, albidus, ad basem mycelio. Sporae carneae, angulatae, 11-16 $\times$ 8 μ. Apud muscos. S.A.—Port Lincoln.

557. *L. tabacina,* n. sp.—Pileus 1·8-2·5 cm., convexus, umbilicatus, subfibrillosus, substriatus, tabacinus. Lamellae adnexae, subconfertae, ventricosae, pallido-carneo-cinnamoneae. Stipes 3·7 cm., tenuis, sursum attenuatus, nitidus, subcavus, "bistre" vel luteo-brunneus, supra pallidior. Sporae angulatae, 6·5 μ, 7·5-8 $\times$ 5·5 μ. S.A.—Stirling West, Mount Lofty, Eagle-on-the-Hill.

558. *L. radicata* n. sp.—Pileus ad 2·5 cm., irregulariter convexus, umbilicatus, subfibrillosus, subfusco-cinereus. Lamellae subdecurrentes, marginibus subcrassis, salmoneo-cinereae. Stipes 1·8 cm., subtenuis, fibrillosus, supra farinaceus, solidus, pileo pallidior, radice longa attenuata. Sporae pyriformes, subirregulares, subcoloratae, 7·5-8 $\times$ 5-5·5 μ. S.A.—Kinchina.

559. *L. fusco-marginata*, n. sp.—Pileus 2·5-3·7 cm., subconvexus vel subplanus, umbilicatus, subfibrillosus, striato-rugosus, margine interdum crenulato, subniger. Lamellae sinuato-adnexae. confertae, angustae, pallido-cinnamoneo-cinereae, marginibus fuscis. Stipes 3·7 cm., tenuis, nitidus, ad basim subbulbosus et albidus, violaceo-subniger. Caro tenuis. Sporae angulatae, 9·5 × 7 μ. S.A.—Back Valley (Encounter Bay).

560.—*Pholiota subtogularis*, n. sp.—Pileus 1·5 cm., convexus, interdum subumbonatus, striatus, subviscidus, ochraceo-luteus vel antimoneo-flavus. Lamellae adnatae, subconfertae, pallido-fulvae, deinde ferrugineo-cinnamoneae. Stipes 3-4 cm., tenuis, subflexuosus, fibrillosus, subcavus, pallido-brunneus. Annulus superior fulvus. Caro tenuis, sub-brunnea. Sporae ellipticae, fulvae, 8-8·5 × 5·5 μ. In terra. S.A.—Mount Burr (S.E.).

561. *Ph. serrulata*, n. sp.—Pileus 1·8-4·3 cm., conico-convexus vel convexus, interdum umbilicatus, interdum umbonatus, hygrophanus, ad marginem striatus, "Verona brown," "Argus brown," fulvus vel ochraceo-fulvus, exsiccatus carneoluteus vel ochraceo-luteus. Lamellae adnatae vel subdecurrentes, subconfertae, angustae, marginibus serratis, ochraceo-fulvae, "Argus brown" vel "Kaiser brown." Stipes 1·8-3·7 cm., tenuis (ad 3·5 mm.), subaequalis, solidus, albidofibrillosus, subter fibrillis similiter lamellis coloratis, ad basim albidus. Annulus albidus, praetenuis, subdistans. Sporae ellipticae, flavo-brunneae, 6·5-9 ×4-6 μ. In terra. S.A.—National Park, Mount Lofty, Mylor.

562.—*Ph. graminum*, n. sp.—Pileus 1·2-1·8 cm., convexus vel subhemisphericus vel subplanus, non-striatus, interdum subumbonatus, hygrophanus, rufobrunneus deinde pallidus. Lamellae adnatae vel dentibus decurrentibus, confertae, ferrugineae, primo pallidiores. Stipes 3·7-4·3 cm., striatus, sub-bulbosus, cavus, pallido-brunneus, ad basim mycelio albido. Annulus subsuperior, membranaceus. Inter gramina. Sporae obliquae, 6·5-8 × 4-5 μ. S.A.—Kinchina, Adelaide.

563. *Ph. imperfecta*, n. sp.—Pileus 1·2-1·8 cm., convexus deinde subplanus, usitate subumbonatus, interdum ad marginem striatus, hygrophanus, ceraceo-flavobrunneus, exsiccatus "Sayal brown." Lamellae adnatae, subconfertae, rufobrunneus vel ferrugineo-cinnamoneus. Stipes 2·5 cm., tenuis, solidus vel cavus, fibrillosus, pallidus vel rufo-brunneus. Annulus superior vel subdistans, imperfectus, albidus. Sporae obliquae, subangustae, 7·5-9·5 × 4·5-5 μ. In terra. S.A.—Second Valley Forest Reserve, Beaumont Common, McLaren Vale.

564. *Ph. squarrosipes*, n. sp.—Plantae in terra apud truncos Eucalyptos percaespitosae vel interdum solitariae. Pilei 1·8-7·5 cm., perconvexi, saepe irregulares, interdum umbonati, subviscidi, subglabri vel interdum fibrillosi, ochraceofulvi, fulvi, antimoneo-flavi, vel "Empire yellow." Lamellae adnatae vel dentibus decurrentibus, subconfertae, subangustae, fuscae, flavo-ochraceae, "buckthorn brown" vel isabellinae. Stipites 3·7-8 cm., tenues vel subcrassi, deorsum, subattenuati, perfibrilloso-squamosi, solidi, "deep colonial buff" vel antimoneo-flavi. Sporae ellipticae, obliquae, fusco-brunneae, 6·5-8 × 4-4·5 μ. S.A.—Encounter Bay, Upper Tunkalilla Creek.

565. *Cortinarius (Phlegmacium?) lilacino-fulvus*, n. sp.—Pileus 6·2-8·7 cm., irregulariter convexus, in medio interdum concavus, denique subrepandus, viscidus, subfibrillosus, argillaceo-coloratus, in locis pallidior vel brunneus, interdum flavo-ochraceus. Lamellae adnatae vel sinuatae, subconfertae, subventricosae, pallido-brunneae deinde fulvo-olivaceae. Stipes 5-6·2 cm., tenuis vel crassus (ad 1·8 cm. latus), aequalis vel attenuatus infra vel supra, fibrillosus, interdum subcavus, sub-bulbosus, ochraceo-fulvus vestigiis lilacinis. Caro sub-brunneus vestigiis lilacinis. Sporae obliquae, 9-11 × 5·5-7·5 μ. S.A.—Stirling West, Mount Lofty.

566. *C. (Ph.) vinaceo-lamellatus,* n. sp.—Pileus 5 cm., subconico-convexus deinde convexus, usitate umbonatus, denique irregulariter convexus, subviscidus, subfibrillosus, cinnamoneo-luteus vel "Sayal Brown." Lamellae sinuatae dentibus subdecurrentibus, subconfertae, 5 mm. latae, vinaceo-cinereae. Stipes 7·5 cm., crassus (1-1·5 cm.), bulbosus (2·5-3·5 cm.), supra attenuatus, non-viscidus, sericeo-fibrillosus, solidus, brunneo-pallidus. Velum albidum. Caro subviolacea. Sporae obliquae, 9-11 × 4·5-5 μ. S.A.—Mount Lofty.

567. *C. (Ph.) ochraceo-fulvus,* n. sp.—Pileus 4·3-6·2 cm., subconvexus, irregularis, subumbonatus, subtiliter fibrillosus, fulvo-olivaceus vel ochraceo-fulvus. Lamellae subsinuatae, subconfertae, subventricosae, fulvo-olivaceae. Stipes 6·2 × 0·6-1 cm., subaequalis, ad basim sub-bulbosus, fibrillosus, infarctus, sub-brunneus. Caro pallido-brunnea. Sporae obliquae, fulvo-brunneae, 9-11 × 5-6·5 μ. S.A.—Stirling West.

568. *C. (Ph.) fragilipes,* n. sp.—Pileus 2·5-8·7 cm., convexus, deinde subconvexus vel irregulariter planus vel repandus, usitate subumbonatus, radiato-fibrillosus, subviscidus, ochraceo-fulvus, fulvus, russus vel aureo-fulvus. Lamellae adnatae dentibus subdecurrentibus, subconfertae, ad 1 cm. latae, carneo-lutaceae deinde fulvo-olivaceae. Stipes 7·5-10 cm., subtenuis, saepe flexuosus, aequalis, fragilis, sericeo-fibrillosus, subcavus, concolorus. Sporae obliquae, flavo-brunneae, 9·3-13-15·5 × 6-7 μ. Plantae subcaespitosae. S.A.—National Park, Mount Lofty, Kuitpo, Second Valley.

569. *C. (Ph.) radicatus,* n. sp.—Pileus 8·7 cm., irregulariter convexus, usitate subgibbosus, deinde irregulariter expansus, viscidus, ad marginem subfibrilloso-striatus, pallidus vestigiis flavo-cinnamoneis, in senectute flavo-cinnamoneus vel deusto-brunneus. Lamellae adnatae vel adnato-subdecurrentes, ad 6 mm. latae, subconfertae, non ventricosae, albidae deinde cinnamoneae. Stipes supra terram 1·2-3·7 cm., bulbosus, radice conica longa (5 cm.), crassus (1·2-2·3 cm.), solidus, albidus, in senectute vestigiis sublilacinis. Caro alba, vestigiis sublilacinis. Velum albidum. Sporae obliquo-ellipticae, 9-13 × 5·5-7 μ. S.A.—Willunga Hill, Waitpinga, Mount Compass, Mount Lofty, Kinchina.

570. *C. (Myxamicium) sinapicolor,* n. sp.—Pileus 5-7·5 cm., subconvexus, subumbonatus, glutinosus, ad marginem sinapicolor, in medio succino-brunneus. Lamellae sinuato-adnexae, subconfertae, 7 mm. latae, "Buckthorn Brown." Stipes 6·2 cm., subcrassus (1 cm.), supra fibrillosus, sub-bulbosus, subflavus. Vellum pallido-flavum. Sporae obliquo-ellipticae, subasperae, 7·5 × 4 μ. S.A.—National Park.

571. *C. (M.) microarcheri,* n. sp.—Pileus 1·8-6·2 cm., convexus vel subplanus, substriatus, glutinosus, perviolaceus vel violaceo-brunneus, exsiccatus-tabacino-brunneus vel succino-brunneus. Lamellae subsinuatae vel adnexae, subconfertae, pallido-violaceae vel violaceo-brunneae, deinde tabacino-brunneae. Stipes 3·1-5 cm., subtenuis, ad basim subcrassus, fibrillosus, subcavus vel solidus, pallidus vel pallido-violaceus. Caro subviolacea vel albida. Sporae obliquae, subglobosae, glabrae, 5·5-8·4 × 4·5-5 μ. S.A.—Mount Lofty, Eagle-on-the-Hill.

572. *C. (M.) albidus,* n. sp.—Pileus 3·7-6·2 cm., convexus, deinde planus, subumbonatus, glutinosus, glaber, deinde subfibrillosus, albidus, deinde pallido-luteus. Lamellae sinuato-adnexae, ventricosae, 9 mm. latae, subconfertae, pallido-ochraceo-luteae vel ochraceo-luteae. Stipes 6·2 cm., subcrassus (1·2 cm.), aequalis vel sub-bulbosus, fibrillosus, albidus vestigiis subviolaceis. Caro tenuis, albida vestigiis subviolaceis. Velum sub-brunneum. Odor "of curry powder." Sporae obliquae, flavo-brunneae, 9·5-13 × 6 μ. S.A.—National Park.

573. *C. (Inoloma) areolato-imbricatus,* n. sp.—Pileus 7·5-15 cm., perconvexus, subirregularis, siccus, squamis subfibrillosis subcarneo-luteis vel pallidis

(in medio subareolatis, ad marginem imbricatis), ochraceo-luteus vel cinnamoneo-luteus. Lamellae adnatae vel adnexae, interdum subsinuatae, subconfertae, ad 1 cm. latae, ochraceo-luteae vel cinnamoneo-luteae et ochraceo-fulvae. Stipes 5·6-6·2 cm., crassus (1·8-3·1 cm.), subaequalis vel in medio inflatus, ad basim attenuatus, fibrillosus, approxime "Warm Buff." Caro firma, in medio 1 cm. lata, alba. Velum albidum. Sporae obliquae, flavo-brunneae, 9 × 4·5 μ. Plantae caespitosae. S.A.—Willunga Hill.

574. *Inocybe serrata*, n. sp.—Pileus 1·2 cm., convexus, fibrillosus, Verona-brunneus vel pallido-brunneus. Lamellae adnatae, marginibus serratis et interdum pallidioribus, tabacino-brunneae vel ligno-brunneae. Stipes 1·8-3 cm., tenuis, attenuatus, fibrillosus, approxime "Warm Buff." Caro firma, in medio 1 cm. lata, farinaceus, pallido-brunneus. Sporae glabrae, obliquae, pallido-flavo-brunneae, 7·5-9 × 4·5-5 μ. Cystidia fusiformes vel ampulliformes, 27-56 × 11-13 μ. Plantae gregariosae vel subcaespitosae, basibus villosis. S.A.—Mount Lofty, Upper Tunkalilla Creek.

575. *I. fulvo-olivaceae*, n. sp.—Pileus 1·2 cm., perconvexus (magis minusve), subfibrillosus, fulvo-olivaceus. Lamellae adnatae, ascendentes, subconfertae, pallidiores quam "Saccardo's Umber." Stipes 2·5 cm., tenuis, granulosus, subcavus, pallido-brunneus, saepe supra subroseus. Sporae subtriangulares, perobliquae, 6·5-7 × 4 μ. Cystidia subventricosa, 45 × 15 μ, 65 × 17 μ. S.A.—Belair.

576. *I. granulosipes*, n. sp.—Pileus 1·2-1·8 cm., convexus, umbonatus, fibrillosus, tabacino-brunneus ad "Bister." Lamellae adnatae, subconfertae, subventricosae, tabacino-brunneae. Stipes 1·8-2·5 cm., subtenuis, e farcto subcavus, aequalis, sub-bulbosus, "Bister" granulis albidis farinaceis vel fibrillosis. Caro pertenuis. Sporae obliquae, 8·5 × 5 μ. Cystidia inflata ad angusto-fusiformia, 45 × 19 μ, 50 × 9 μ. Plantae gregariosae. S.A.—Stirling West, Mount Lofty.

577. *I. Murrayana*, n. sp.—Pileus ad 1·6 cm., conicus, deinde expansus, umbonatus magis minusve, subtili-fibrillosus vel fibrilloso-squamosus, sericeo-nitidus, cinnamoneo-brunneus vel "Buckthorn Brown" vel "Dresden Brown" vel russus. Lamellae adnatae vel adnexae, subconfertae, marginibus subserratis, tabacino-brunneus vel avellaneus. Stipes 2·5 cm., aequalis, subtili-striatus vel fibrillosus vel farinaceus, solidus, tabacino-brunneus vel brunneo-pallidus. Sporae obliquae, pallido-brunneae, 9-11-13 × 5·2-5·5 μ. Cystidia acuminata basi inflata vel ventricosa, 85 × 11 μ. S.A.—Kinchina.

578. *Astrosporina emergens*, n. sp.—Pileus ad 3 cm., ad 1·5 cm. procerus, irregulariter lato-conicus, subfibrillosus vel subglaber, pallido-luteus. Lamellae adnatae vel adnexae, confertae, pallido-brunneae. Stipes ad 2·5 cm., subcrassus, ad basim sub-bulbosus, albus, deinde sub-brunneo-albidus. Sporae angulatae, pallido-brunneae, 7·5 × 4 μ. Cystidia ampullaformia apicibus asperis, 25-37 × 13 μ. S.A.—Kinchina.

579. *A. exigua*, n. sp.—Pileus ad 1·2 cm., convexus vel campanulatus, subfibrillosus, cinnamoneo-brunneus. Lamellae adnatae, subconfertae, subcinnamoneae. Stipes 1·2 cm., subfibrillosus, albidus. Sporae nodosae, 8-8·5 μ. Cystidia pauca ampullaformia apicibus glabris. S.A.—Hope Valley.

580. *A. discissa*, n. sp.—Pileus 2·5 cm., convexus, umbonatus, perfibrillosus, discissus, brunneus. Lamellae liberae, ventricosae, brunneae. Stipes 2·5 cm., subtenuis, primitus subpruinosus deinde glaber, aequalis, ad basim sub-bulbosus, albidus vel pallido-brunneus. Sporae nodosae, brunneae, 9 × 6 μ. S.A.—Upper Tunkalilla Creek.

581. *A. imbricata*, n. sp.—Pileus ad 16 mm., convexus vel subconico-campanulatus, fibrillis adpressis umbricatis, fusco-brunneus. Lamellae adnatae, deinde secedentes, subconfertae, subventricosae, fusco-brunneae. Stipes 16 mm.,

subtenuis, aequalis, infarctus, fibrillosus, pallido-brunneus. Caro pilei pallida, stipis sub-brunnea. Sporae angulatae, 9-11 × 5·5 μ. S.A.—Kinchina.

582. *Flammula punctata,* n. sp.—Pileus 2 cm., convexus, interdum subumbonatus, dum humido viscidus, rubro-fulvo-brunneus. Lamellae adnatae vel emarginato-adnatae, subconfertae, pallido-cinnamoneae. Stipes 1·8-2·5 cm., tenuis, solidus, pallidus squamoso-fibrillis fuscis, carne subcartilaginea. Sporae obliquo-ellipticae, pallido-flavo-brunneae, 7·5 × 4 μ. S.A.—Back Valley, off Inman Valley.

583. *F. cincta,* n. sp.—Pileus 1·2-3·1 cm., convexus, deinde planus, denique repandus, dum humidus viscidus et ceraceo-brunneus, hygrophanus, exsiccatus carneo-lutaceus, primitus ex velo albo-farinaceus. Lamellae adnatae vel adnato-decurrentes, subconfertae, subangustae, primitus minute serratae, pallido-cinnamoneae deinde brunneo-cinnamoneae. Stipes 2·5-3·1 cm., subtenuis, aequalis vel infra attenuatus, sub-bulbosus, subfarinaceo-fibrillosus, subcavus, albidus deinde sub-brunneo-albidus. Primitus velo universali albido farinaceo. Sporae ellipticae, pallido-brunneae, 8-8·5 × 4·5 μ. In ligno carioso cum mycelio albido agglutinante. S.A.—Back Valley, off Inman Valley.

584. *F. brevipes,* n. sp.—Pileus, 5-6·7 cm., irregulariter convexus, repandus, ochraceo-fulvus vel fulvus. Lamellae adnatae, subconfertae, ventricosae, 10 mm. latae, ochraceo-fulvae vel fulvae. Stipes perbrevis, 18 mm., striatus, brunneo-fibrillosus, pallido-flavus. Sporae obliquae, flavo-brunneae, 9 × 5·5 μ, rariter 11·5 × 7·5 μ. In terra. S.A.—Kalangadoo.

585. *Naucoria arenacolens,* n. sp.—Pileus 2·5-4·4 cm., convexus, deinde expansus, subirregularis, innato-fibrillosus, "Sayal Brown." Lamellae sinuatae, subconfertae, perventricosae, 3-5 mm. latae, marginibus pallidioribus et minute serratis, tabacino-brunneae. Stipes 2·5-3·7 cm., subcrassus (8-10 mm.), aequalis, fibrillosus, solidus, subcarneo-alutaceo-pallidus. Sporae pallido-brunneae, elongatae, 9·5-13 × 4 μ. S.A.—Encounter Bay.

586. *Psalliota vinacea,* n. sp.—Pileus ad 10 cm., e conico-hemispherico convexus, deinde expandens, fibrillis vel fibrilloso-squamis adpressis, cinnamoneo-cinereus vel vinaceo-brunneus. Lamellae liberae, subconfertae, primitus pallidae, deinde pallido-vinaceo-cervinae. Stipes 7·5-8·7 cm., crassus (1·2 cm.), fibrillis floccosis, interdum ad basim sub-bulbosus, solidus vel subcavus, albidus. Velum album. Annulus amplus, subdistans. Caro sub-brunnea. Sporae purpureo-brunnea, 5·5 × 3·5 μ. Sub Eucalyptus. S.A.—National Park.

587. *Panaeolus paludosus,* n. sp.—Pileus 4·3 cm., conico-hemisphericus, deinde convexus, glaber, subrivulosus, fuscus, medio exsiccato pallidiore ad peripherem zonatus. Lamellae adnexae, subconfertae, ventricosae, nubilo-cinereae. Stipes ad 10 cm., tenuis, subflexuosus, subpruinosus, subfibrillosus, subcavus, infra fuscus, supra pallidior. Sporae limoniformes, subnigrae, 10-11 × 7·5 μ. In terra paludosa. S.A.—Mount Compass.

588. *Russula persanguinea,* n. sp.—Pileus 3-10 cm., subconvexus medio concavo, denique interdum subrepandus, usitate ad peripherem substriatus vel tuberculo-rugosus, viscidus, sanguineus. Lamellae adnexae, ad stipem attenuatae, aequales, raro furcatae, subangustae (6 mm.), confertae, albae. Stipes 3·7-5 cm., crassus, glaber vel substriatus vel subrugosus, solidus vel cavus, albus. Caro tenuis, fragilis. Sapor mitis vel sub-piperatus. Sporae verrucosae, albae, 7·5-11 μ, 9 × 7·5 μ. Cystidia in pileo acuminata basibus latis, 19-38 × 7·5 μ. S.A.—Mount Lofty, Morialta.

589. *R. viridis,* n. sp.—Pileus 5-6·2 cm., convexus medio subdepresso, nonstriatus, pelle separabili, subviscidus, viridis. Lamellae aequales, ad stipem attenuatae, subconfertae, angustae, interdum proxime stipem furcatae, cremaceo-

albae. Stipes 3·7-4·4 × 1·6 cm., subrugosus, infra inflatus, supra attenuatus vel aequalis, solidus albus. Caro fragilis, alba. Sapor mitis. Sporae spherico-pyriformes, subtiliter verrucosae, albae vel subcremaceo-albae. 7·5-9 × 5·5-6·5 μ. Cystidia in pileo nulla. S.A.—Mount Lofty.

590. *Coprinus arenacolens*, n. sp.—Pileus 4·4 cm., subhemisphericus, deinde convexus, striatus, pallido-brunneus. Lamellae adscendentes, subadnexae, latae, cinereae. Stipes 3·7-15 cm., crassus, sursum attenuatus, substriatus, fibrosus, solidus, annulo aspero elevato distante, albidus deinde substramineo-albidus. Sporae ellipticae, nigrae, 13-17 × 7·5 μ. In arena pura. S.A.—Davenport Creek (E.P.).

591. *C. virgulacolens*, n. sp.—Pileus 1·2-2·5 cm., 16 mm. altus, cylindrico-conicus ad lato-conicus, deinde se expandens, membranaceus, disco glabro subconvexo fusco, striato-plicatus, pallido-furfuraceo-granulosus, cinereo-brunneus. Lamellae subadnexae vel adnatae, primum adscendentes, confertae, angustae, albidae, deinde purpureo-brunneae. Stipes 3·7-6·2 cm., granulosus et striatus, deinde glaber, concavus, sub-bulbosus, albus. Caro pertenuis, brunnea. Sporae obliquae, fuscae, 7·5-9 μ, interdum 11 × 4-5 μ. Plantae in terra virgulis applicatae. S.A.—Mount Lofty.

592. *Dictyolus australis*, n. sp.—Planta alutaceo-brunnea. Pileus spathulatus vel flabelliformis, 6 mm. latus et longus, glaber, interdum subsulcatus. Lamellae decurrentes, subdistantes, furcatae, marginibus crassis. Stipes 6 mm., lateralis, deorsum subattenuatus, glaber. In terra muscosa. S.A.—Kinchina.

593. *Paxillus psammophilus*, n. sp.—Pileus 8·7 cm., flabelliforme-dimidiatus, subfibrillosus, deinde rimosus, brunneus. Lamellae decurrentes, confertae, ad stipem reticulatae, sub-brunneae. Stipes brevis (2·5 cm.), sublateralis, tenuis, radice longa angusta. Sporae elongatae, albae, 13-13·5 × 4 μ. In arena. S.A.—Elliston.

ON MAMMALS FROM THE LAKE EYRE BASIN.

PART I.—THE DASYURIDAE.

By H. H. Finlayson,
Hon. Curator of Mammals, South Australian Museum.

[Read October 12, 1933.]

The reappearance of *Caloprymnus campestris*, in 1931,[1] in the eastern portions of the Lake Eyre Basin, was not an isolated episode in the history of the local mammals, but was rather the outcome of causes largely connected with the passing of drought conditions, which by restoring herbage over large denuded areas, led to a sudden marked increase in the numbers of most of the smaller mammals and culminated in one of the now familiar migratory rodent plagues.

While matters appertaining to *Caloprymnus* were the chief pre-occupation of the writer while there, no opportunities were lost of obtaining a representative collection of all the local mammals, and since my departure, several generous correspondents have made important additions both of material and data. For services in this connection I am particularly indebted to Mr. L. Reese, to Mr. H. R. Adamson of Elder, Smith & Co., to Mr. Shelton, of Cordillo, Master Dick Scobie, Constable John Finn, Mr. George Aiston and Mr. D. N. George.

While the collections so formed fall far short of that necessary for an adequate survey of the mammals of this remarkable area, they have brought to light several new forms, and in other cases adequate series of specimens have enabled me to add to knowledge of animals, formerly obscure, owing to their rarity in collections.

The area from which most of the data and specimens herein recorded were derived, comprises the extreme north-eastern corner of the State of South Australia, and may be approximately defined by producing the western and southern boundaries of Queensland into South Australian territory until they meet, near the south-eastern corner of Lake Eyre North. Within this square, again, work was concentrated largely on the tracts between the Barcoo and Diamantina, which for various reasons are more suitable for collecting.

Hitherto, collecting here has been of a desultory and incidental character and, owing to the insignificance numerically, of its mammal population in normal years, to the decline of the blacks and consequent loss of expert aid, and the rigours of climate, the country is not one of many attractions to the mammalogist. It is, nevertheless, an area of great interest ecologically and, on the rare occasions of a resurgence of life, well repays the considerable amount of energy which one must spend upon it in order to get results.

The Physical features of the area are highly characteristic, and together constitute a type of environment distinct from other parts of the centre. Four main physiographical units may be recognised which, to a slight extent, are valid also as zones of distribution.

(1) Parallel sand ridges, usually north and south in direction and frequently of great linear extent, but disposed in narrow belts seldom more than a mile or so wide and frequently limited to a single ridge, which may extend unbroken for 20 or 30 miles. These long ridges are permanent and are, indeed, not sandhills

(1) Trans. Roy. Soc. S. Aust., vol lvi. (1932), pp. 148-167.

proper, but loamy elevations blanketed to varying depths with loose sand. Near the east shores of the Lake, however, and south of the Barcoo, are true drifting dunes with no firmer core.

(2) Loamy flats. These may take the form of long strips constituting the interspaces of the sand ridge belts or may be more extensive depressed areas or basins, like Goyder's lagoon. In the former case the surface supports small herbaceous plants only, but in the latter there is usually a fairly dense growth of the so-called lignum *(Muehlenbeckia Cunninghamii)*, which sometimes attains 10 feet in height, and then constitutes the nearest approach to a thicket to be found in the district.

(3) The gibber plains. In their surfaces these vary in texture from a loose rubble, which may support a small bush flora, to closely arranged pavements from which are excluded all but the grasses, which, however, are only in evidence after heavy rains. In extent, they may range from a few acres, to huge expanses like Sturt's Stony Desert, extending 120 miles north and south and width up to 35 miles.

(4) The river channels. Although the first three types of country alternate with one another so as to account for the greater part of the land surface, the river channels of the Diamantina and Barcoo, while involving but trifling areas in their normal courses, are, nevertheless, of interest as affording the only permanent waters of the area and the only considerable belts of timber, their banks being lined with Coolibah and *Bauhinia*. From the point of view of distribution these features form a minor but sharply defined habitat zone, to which the single aquatic and the single arboreal mammal of the area are exclusively restricted.

Away from the river channels, the whole surface, sandhills, flats and gibber plains is characterised by excessive aridity and high temperatures throughout the greater part of the year. The vegetation, which has been dealt with in detail by Cleland, Black, and Reese,[2] is sparse, made up almost entirely of very small species, and so scattered as to leave the ground surface nearly naked. In spite of this quantitative deficiency, however, there is a large percentage of good fodder plants, and nominally the whole area is taken up for pastoral purposes, but this enterprise is not carried on with sufficient concentration to affect the flora and fauna appreciably, except in a few restricted localities.

The almost complete absence, away from the channels, of arborescent plants or of species forming moderately compact communities, is a striking feature, and the resulting absence of shade and shelter is, no doubt, largely responsible for the elimination from the mammals, of almost all but strictly fossorial forms.

The conditions mentioned impose upon the area a strongly developed eremian character, which, however, is curiously modified in certain parts from time to time, by the flooding of the Diamantina and Barcoo by rains in the Queensland hills, 700 miles away. At such times large areas of the loamy flats contiguous to the channels are inundated, and may remain so for weeks at a time. When the water is absorbed herbage is quickly restored on a scale of unwonted lavishness, which leads in turn to a corresponding increase in animal life, similar (if more localized) to that which follows a general rain.

In the portions of the district remote from these influences, the prevailing colour of the gibbers and the sand alike is a rich ferruginous brown, but in the flooded areas this becomes bleached to a pale drab. The flooded country is but a small fraction of the total area of the Basin, but is, nevertheless, its chief mammal station, and the colour change mentioned is a significant one in local bionomies, since there is little doubt that the curious ochraceous pallor which distinguishes

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(2) Trans. Roy. Soc. S. Aust., vol. xlix. (1925), p. 103.

the colouration of nearly all its small mammals, is a character adapted to the prevailing tone of the landscapes.

The rivers have a further interest in that they tend in some measure to break down the geographic isolation of the Basin, and they are, potentially at least, intermittent lines of communication linking this portion of the Eremian Sub-region with the Torresian half of the Euronotian belt. Although they are no longer regular lines of migration so far as the mammals are concerned, it is probable that two species of rodents gained access to the Lake Eyre Basin by this route at no very distant time.

SMINTHOPSIS CRASSICAUDATA CENTRALIS (Thomas).

"Nilee" of the Wonkonguroo.[3]

Ordinarily, apparently, an uncommon or even rare animal in the district, but multiplying to an extraordinary extent during the mouse plagues of 1930-1932 and following the migratory waves of *Mus musculus* from north to south throughout the area. At the same time local increases in the numbers of the typical variety took place in the settled districts, as for example at Mildura and Renmark on the Murray.

There seems no reason for doubt that at these times it forsakes its ordinary insectivorous habit and becomes truly carnivorous and predatory. Though I cannot vouch personally for any instances of its killing mice, stories of its enterprise and ferocity in so doing are admiringly told by blacks and whites alike. At the height of the plague in 1931, Mr. Reese took scores of Nilees inadvertently in improvised kerosene tin mouse traps, and when so caught it at once proclaims its presence by its remarkably loud shrill hissing cry.

Throughout the summer of 1931 it lived in shallow burrows on all types of country, but Mr. Aiston tells me that in the early part of 1932, at Mulka, while breeding freely, it was found in nests on the surface. With the subsidence of the mouse plagues it disappeared as suddenly as its prey, but the taking of specimens from holes in the following winter, in a sluggish condition very different from its usual vivacity, suggests that a partial hibernation may partly explain the mystery, though attempts to induce hibernation in this and allied species, in captivity, have met with no success.

The general colour of the type of the variety *centralis*, which came from Killalpannina on the Barcoo, was stated by Thomas, to be a pale isabella finely grizzled with brown, but the ground colour of the dorsum, in the present series of 22, is remarkably inconstant, and varies from a curious brassy "olive buff" through several shades of buffy grey to a rich vinaceous cinnamon. The differences do not appear altogether capriciously, however, but represent to some extent at least, adaptations to the prevailing colour of the environment during periods when the *Sminthopsis* population is stationary. The paler forms appear in the bleached sandhill-claypan country near the channels, and the richer pink forms in the red gibber plains.

From *S. crassicaudata,* as it occurs in the South-Eastern district of South Australia (where it is more plentiful, normally, than elsewhere in the State), the variety *centralis* differs markedly, not only in its brighter colouration but in some structural features as well.

The bodily size is very variable in both localities, but the central form is lighter in build and with longer limbs and appendages. The ear is not only pro-

(3) The aboriginal names quoted are, in most cases, those used by Wonkonguroo hunters, but in many cases are not original to that people but have been borrowed from the Yalliyandas, Yaurorkas and Dieries.

portionately much longer[4] but is broader as well, and the total area of the pinna is thus greatly increased. The tip, moreover, is more sharply pointed and the whole feature more prominent than in the south. The curious trizoned pigmentation of the epidermis of the ear, apparently characteristic of the species over the whole of its range, is on the same pattern as in true *crassicaudata* but is much more marked, as are also the similar pigmented areas on the mystical sites of the muzzle. The tail is from 50-60% longer. Its incrassation in this species, in all parts of South and Central Australia, is so variable as to render it useless as a diagnostic feature, but in *centralis* its maximum development is greater than in the southern form. In life the epidermis of the tail is pigmented a dark slate, but in alcohol this fades rather quickly.

The manus shows little change, but the pes is larger; its naked granular portion extends obliquely as a wedge-shaped strip from a point just proximal to the hallux, to the bases of the nails. A feebly developed hallucal pad is sometimes present. The main interdigital pads are granular, but there is a distinct tendency for the midline of their surfaces to be occupied by a single longitudinal series of enlarged granules, whereas in the southern form the pads are more finely granulated and without any regular arrangement of granules.[5]

It has not been expedient to extract skulls from the whole series, but 6 have been examined, and these would appear to indicate that in *centralis* the canine is slightly longer, the disproportion in size of the premolars less, and the posterior margins of the nasals more sharply angulated, than in the southern *crassicaudata*. These differences are slight, however, and the chief skull measurements may be merged with those of the southern animal.

The skull of one of the largest males gives:—Basal length, 23·3; zygomatic breadth, 13·3; nasals length, 9·9; intertemporal, 4·7; palate length, 12·8; $M^{s1\cdot3}$, 4·5.

In the series examined (22), males outnumber females by 2 to 1.

Mammae either 8 or 10.

The form of *S. crassicaudata,* which occurs in the south-east of South Australia, may apparently be reconciled with the typical variety of Gould's original description. The differences which separate it from *centralis,* over 1,000 miles north in a very different environment, are so marked as to suggest the propriety of separating the latter specifically from the earlier known animal.

In testing the grounds on which such a step might be taken, I have been led to examine all the specimens in the South Australian Museum (some 50 in all), which come from intermediate and still more northerly localities. While there is a considerable individual variation which is responsible for the occasional appearance of similar individuals at widely sundered places, the chief result of this analysis has been to reveal a steady change in colouration, and in the length of tail and ear, as one proceeds from south to north, together with the retention, almost unmodified, of skull characters, foot structure and pattern of markings.

The intergrading of the variable features is so complete as to leave little doubt as to the derivative relations of the whole series, and anything more than subspecific distinctions are thus unjustified.

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(4) The form from the southern parts of the State was stated by Wood-Jones to be longer eared than that from more arid Northern districts (Mammals of S. Aust., vol. i., p. 114). I am unable to confirm this, however, by reference to the series preserved here, and the specimens from the Adelaide district, of which measurements are given, have a proportionately much shorter ear than the form now under consideration (in the ratio of 14:20·4).

(5) Occasionally a single large granule may occur on the surface of the pad, but the disproportion between it and its fellows is usually not great and it does not always occur on the point of contact of the pad with the ground—it is an aberration, rather than a functional specialization such as occurs in *S. larapinta.*

Beginning in the south-eastern district with a cold, ashy grey, short eared and very short tailed form, there is, on coming north, a steady increase both of the fulvous colours of the coat and of the length of ear and tail. In the northern mallee, and on Yorke and Eyre Peninsula, distinctly yellowish forms are already met with which, at Kooringa, Kingoonya, Copley and Farina, on saltbush tablelands, change to a bright tan, noticeably long-tailed form, and the trend culminates in the Macdonnell Range with the production of a brilliant ferruginous phase,[6] with distinctly yellowish ventral fur and dimensions identical with those of the Diamantina specimens.

In point of colour the pallid buff and vinaceous tones of the latter stand somewhat apart from this sequence, and have obviously been developed in response to the peculiar conditions of the Basin. If, therefore, the name *centralis* is retained for the pallid form of this area, it will be necessary to accord an equal degree of distinction to the richly-coloured variety which diffuses south from the Macdonnells and which is equally distinct from the true *crassicaudata* of the south.

It may be called, provisionally, *Sminthopsis crassicaudata ferruginea,* but a detailed diagnosis is deferred pending further investigation.

Mr. Troughton has recently called attention to the doubts which may arise as to the specific uniformity of some small mammals which in the past have been accorded very wide ranges in Australia. No doubt there is room for close scrutiny in all such cases, but it would be regrettable if an over-free use of specific names were allowed to obscure the fact that several adaptable marsupials have successfully colonised huge tracts presenting a wide range of ecological conditions, without undergoing important structural changes in so doing. That *S. crassicaudata* is one such, I hold to be certain.

Dimensions of *S. crassicaudata centralis*, in mm.

	Mean of 13 ♂	Mean of 7 ♀.	Largest ♂.	Largest ♀.
Head and body - -	70·9	74·0	83	83
Tail - - - - -	70·1	67·3	66	64
Pes - - - - -	16·0	15·3	16	15
Ear - - - - -	20·4	20·4	21	21

SMINTHOPSIS LARAPINTA (Spencer) (var.?)

"*Melatjhanie.*"

This species appears to be much less numerous than the "Nilee," from which, however, it does not seem to be distinguished by any important features of habits or distribution, though it should be observed that such matters tend to be obscured in a time of general increase. It was stated by Mr. Byrne that at Charlotte Waters *larapinta* lives on the stony tablelands, and *crassicaudata* on the sandhills and creeks.

In a superficial view it comes rather close to *crassicaudata centralis,* and dorsal colour, face and ear-markings are almost exactly as in the intermediate specimens of the latter. From this animal, however, it is sharply separated at all stages of growth by its much longer tail, which exceeds the head and body by 25-30%, by the shorter, more rounded ear, and especially by the interdigital pads of the pes which are always surmounted by a large oval tubercle, exceeding the granules which surround it by 3 or 4 diameters They are smooth or very obscurely striate.

Mammae 8.

(6) Co-existing, however, with duller individuals.

On comparing it with the typical *larapinta* described by Sir Baldwin Spencer from Charlotte Waters, I have been able to support his description by examination of a series of six in the South Australian Museum from an unknown locality,[7] and of four from the type locality, kindly made available by Mr. Brazenor, of the National Museum, Melbourne. In the chief structural features, the correspondence with the animal from the Lake Eyre Basin is close. The incrassation of the tail and its resulting shape, however, are much less characteristic than Spencer supposed. In two examples from the Diamantina the tail is as slender as it is in *murina* and in two others in which it is incrassated, it is not very differently shaped from that of *crassicaudata*.

The hallucal pad of Spencer's animal is not a prominent feature in the present series, and the V-shaped smooth elevation surmounting the basal pad of the manus is less sharply sculptured, and its arms tend to coalesce across the intervening space. The differences in colouration between the two series are much the same as those separating the forms of *crassicaudata* from the same localities; *i.e.*, those from the Lake Eyre Basin are paler, with a pure white rather than cream belly, and the brown and tan shades of Spencer's animal are here replaced by pinker hues of ocraceous buff.

The skull of the Lake Eyre animal does not differ in any constant way from that from Charlotte Waters; it is strongly built and more densely ossified than in *crassicaudata* and in old specimens develops distinct crests; the disparity in size of the premolars is also more marked, than in *crassicaudata*.

Dimensions of the largest ♂ and ♀ examined:—Head and body, 90, 83; tail, 110, 105; pes, 18·5, 17; ear, 18, 17.

The skull of the largest male gives:—basal length, 26·5; width, 25·2; nasals, 10·0; palate, 14·1; M^{s1-3}, 4·6.

Five specimens examined.

So little is known of the range of *S. larapinta*, and the few specimens examined have come from such restricted areas, that I do not feel justified at present in claiming the animal as a definite variety, though it is quite probable that such is the case.

The probability of its occurrence in South Australia was pointed out by Wood-Jones,[8] but the above notice is the first definite record of the animal in this State.

CHAETOCERCUS CRISTICAUDA HILLIERI (Thomas).

"Mudagoora."

This beautiful dasyurid, which until now has been known from a single skin in the British Museum, is apparently widely distributed in the area, but during my time there, was not plentiful. It makes its rather shallow burrows chiefly in the sandhill country, and although many were excavated, most of them proved to be deserted, and only a single specimen was then obtained (at Cooncherie). Some few months later, however, its numbers had greatly increased, and seven more examples were forwarded by Mr. G. Aiston, from Mulka, and Mr. D. N. George, from Puttaburra. Moreover, examination of the entire *chaetocercus* collection of the South Australian Museum has brought to light further specimens taken in the same district in 1905, so that altogether 16 have been available for examination.

In their pallid buff colouration, these agree very well with Thomas' *hillieri*, except that the under-surface of the tail is jet black for two-thirds its length and

(7) These were probably obtained (together with some other Dasyurids) from Sir B. Spencer, by exchange, by the late Mr. Zietz, and they probably represent part of the original collection from Charlotte Waters.

(8) Mammals of S. Aust., vol. i., p. 111.

not simply "indistinctly darker," as stated. In estimating its relation to the typical *cristicauda* of the more westerly districts of the Centre, I have had an excellent series of 104 examples of the latter from as far north as Tennant's Creek, south to Ooldea, and west to about 124 E. longitude, in Gibson's Desert. Examination of the whole of this material shows definitely that (1) all specimens reliably localised in the Lake Eyre Basin show the *hillieri* pelage characters very constantly; (2) west of the Basin, *cristicauda* is very variable, but is nearly always much darker and more grizzled, and even its palest phases are more richly coloured and have a more strongly contrasted tail base than in *hillieri;* (3) the two colour types do not co-exist in any part of the range of the species as at present ascertained.

These results leave little doubt, therefore, that Thomas' animal constitutes a valid geographical race of constant pelage characters within the limited area to the east of Lake Eyre, from which it has so far been taken.

Structurally, the present form seems to be practically identical with the western animal, or at least it presents a range of variation in structural features which can be merged in that of the latter. When the skulls of the four largest examples of *hillieri,* taken in the winter of 1932, are compared statistically with a long series of adults of the western form, some small *proportional* differences emerge; thus (1) the degree of intertemporal constriction is greater; (2) the palatal vacuities are larger; (3) the canine is longer; and (4) the molar dentition is slightly weaker, than in *typica.* The differences are slight, however, and do not afford sufficient grounds for founding specific distinctions upon, and the animal is best regarded as a well-marked variety of Krefft's species.

It does not seem to have been noted previously that the unworn canine of *chaetocercus* usually carries a small but distinct cusp upon its posterior carinate margin. The feature is reminiscent of that seen in some bats, and is present in both sub-species.

With regard to dimensions, it is unfortunate that the almost incredible variation in adult size and to a lesser extent in proportions, which is especially characteristic of *Chaetocercus* amongst the Central mammals, largely stultifies any attempt to define the two forms by mensuration. The series of 7 males, taken during the winter of 1932, are far larger and bulkier than any which I have examined from the western areas, but that superior size is not a distinguishing character of *hillieri* is proved, on the one hand by the fact that adults taken in 1905 are very much smaller than 1932 examples, and on the other by the existence of Spencer's record of a giant *typica* male from Charlotte Waters with a head and body length of 220 mm., which greatly exceeds the largest of my *hillieris.*

Flesh Dimensions.—Range of 8 ♂, taken in 1933: Head and body, 164-190; tail, 113-130; pes, 34-37; ear, 26·5-28. Range of 4 ♂, taken in 1905:[9] Head and body, 123-141; tail, 85-109; pes, 29-31; ear, 22-25.

Skull Dimensions.—Range of 4 ♂ taken in 1932, followed by two ♀ taken in 1905:—

Basal length: 39·5-42·2, 35·3-37·1; zygomatic breadth: 28·2-30·3, 25·2-25·8; nasals length: 14·3-16·0, 13·2-14; nasals breadth: 5·6-6·7, 4·5-5·0; constriction: 7·0-7·5, 7·1-7·2; palate length: 21·2-23·2, 20·0-20·5; palate breadth outside M^3: 14·1-15·0, 13·3-13·6; palatal foramina: 2·5-3·0, 2·5-2·8; palatal vacuities: 6·5-7·0, 5·5; height of canine: 4·7-6·8, 4·5; Ms^{1-3}: 8·2-8·8; 8·2-8·5; Max. breadth of M^3: 3·5-3·6, 3·5-3·6.

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(9) Although no females were taken in 1932, it is almost certain that differences in dimensions shown are seasonal rather than sexual. In the western race sexual differences, though present, are not very marked.

Sir Baldwin Spencer states[10] that females of *chaetocercus cristicauda typica* were much more plentiful than males, but this is not borne out by the results of my own observation on this race, and in *hillieri* the position is reversed, as of the 17 specimens now known, 12 are males, and, as mentioned, during the last period of their plenty, only males were taken. Without more detailed knowledge of the life histories and habits than is at present available, however, the determination of sex ratios by simple examination of series of wild, caught specimens is not very satisfactory.

During the rodent plagues, the animal appears to be almost entirely carnivorous, and the stomach contents of all those examined consisted largely of finely comminuted fleshy matter with only a sparse representation of insect debris. Like its larger relative *Sarcophilus* it crushes and ingests large quantities of bone, but the fur which is commonly found in large quantities in the stomach of the latter, is conspicuously absent.[11]

Dasyuroides byrnei pallidor (Thomas).

"Kauäri."

Well known to both the settlers and blacks, but apparently a comparatively rare form which has not participated in the general increase in numbers. No specimen was taken, and the single example of the species in the South Australian Museum represents the darker typical race.

The Dieries, on the Barcoo, speak of a spotted animal, the Yikaura, which was a rare form when they were boys, and which has not been seen for many years; it was, no doubt, a *Dasyurus* species. With this exception no definite accounts could be obtained of any other members of the family, though it is probable that *Antechinomys* occurs here.

(10) Horn Expedition Reports, Mammalia, p. 25.

(11) Cf. Wood-Jones, Mammals of S. Aust., pt. i., p. 108.

ON THE EREMIAN REPRESENTATIVE OF MYRMECOBIUS FASCIATUS (WATERHOUSE).

By H. H. Finlayson.
Hon. Curator of Mammals, South Australian Museum.

[Read October 12, 1933.]

The status of *Myrmecobius fasciatus* beyond the south-western districts of Western Australia, which until now have been considered to be its chief stronghold, has long been a matter of uncertainty.

Its presence in the centre was first established by the work of the Elder Expedition,[1] but that it formerly exended very much further south, almost, in fact, to the coastal districts of the State of South Australia, is attested by the statements of Sir George Grey and the early settlers here, and confirmed by the presence of specimens from the southern part of this State, in the British and South Australian Museums. No definite records of the animal from the south-eastern portions of its range have been obtained for many years, and since most of this area is more or less closely settled, it is also unlikely (as Wood-Jones has opined) that it still survives here.

Recent field work, by the writer, in the far north-west of this State (in a typical eremian environment) has shown, however, that *Myrmecobius* still has a wide distribution in the south-west parts of the centre beyond the limits of pastoral settlement, and in some localities is by no means uncommon. It is possible that these colonies actually link up with the far south-western ones in Western Australia in a continuous band of distribution,[2] and enquiry into these and related matters is proceeding and will be dealt with later in a general account of the Luritja mammals.

But for the present, as an excellent series of the central animal is now available, comparisons have at once been made with a series from south-west Western Australia, and these show that the former, while structurally identical with the typical race, constitutes a distinct colour variety, which I propose to separate under the name

Myrmecobius fasciatus var. rufus.

Size, apparently averaging slightly less than in the typical race, with which, however, it agrees closely in all essential structural features, both external and cranial. As the subspecies is founded entirely on pelage characters, it may be sufficiently defined by listing the points in which it differs from the better-known animal.

(1) The whole of the dorsum is more strongly suffused with rufous. This is particularly noticeable on the crown of the head and the fore-part of the back, where the colouration is constantly a rich uniform brick red (about Ridgway's

[1] Trans. Roy. Soc. S. Aust., vol. xvi. (1892-1896), p. 154.

[2] This is implied by le Souef (Wild Animals of Australia), who gives the range of the animal as extending from "Port August to about the latitude of Perth." But as no detailed records of the species in the intermediate tracts seem to have been published, and as much of the country is quite untouched so far as systematic collecting goes, I presume that Mr. le Souef, in this statement, is estimating the probabilities of the case, rather than stating an ascertained fact.

orange rufous to Sanford brown) sparsely pencilled with pure white, but without black hairs and presenting a very different appearance to the same areas in the typical variety, where (even in the most richly-coloured specimens) these parts are grizzled with white, red, and black.

(2) The transverse light bands of the posterior back may be either pure white or cream and, as regard number, breadth and spacing, they show about the same range of variation as in *typicus*, but in adults there is a constant difference in the colour of the areas which they enclose. In the western form these areas culminate in broad rump bands which are either dark grey or jet black, but in variety *rufus* they are constantly a rich brown (about Ridgway's Mars brown to bay). This colour is subject to marked change on long preservation in alcohol, and in the longest kept examples (taken in 1903) the brown has faded to a ferruginous red, scarcely differentiated from the colour of the foreback. Such examples show the white bands traversing an almost uniform red field, and are strikingly different from fresh examples of either race.

(3) In *rufus*, even in midwinter, the coat shows a much scantier underfur and, as a result, seems more adpressed and somewhat coarser.

(4) The outer surface of the ear is clothed with bright rufous hairs, from base to tip, whereas in *typicus* the ear at the base has a fine grizzle of yellow and black, grading out to pure black at the tip. A good distinction at all stages.

(5) The ventral surface is more variable than the dorsum, but is always some shade of ochraceous tawny and never white as it frequently is in the typical form.[3]

The colour is richer in young animals than in old.

(6) Colouration in the var. *rufus* is much more constant than in *typicus*. All the examples obtained were almost exactly alike dorsally, whereas in the south-west, even in much more restricted localities, scarcely two examples of *typicus* can be got which are closely matched.

Sexual differences in colour and size are negligible.

Skull and *dentition* as is the typical form.

Dimensions.—Range in apparently adult specimens of both sexes; head and body, 200-270; tail, 130-170; pes, 44-47; ear, 25-29.

Skull Dimensions of the co-type M. 3061, ♀; basal length, 53·8; greatest breadth, 29·9; nasals length, 22·8; nasals greatest breadth, 12·5; nasals least breadth, 3·2; intertemporal breadth, 18·0; interorbital breadth, 14·8; palate length, 41·5; palate breadth outside M^4, 11·6; anterior palatal foramen, 3·0; height of canine, 2·7; length of M^3 (worn), 1·7.

Co-types of Subspecies.—Adult ♀, South Australian Museum; registered number, M. 3061 (skin and skull); and adult ♀, South Australian Museum; registered number, M. 3759 (alcohol).

Type Locality.—Mulga sand dunes, south and south-west of the Everard Range, far north-west of State of South Australia.

Range.—At present apparently not north of about 25° S. lat., nor east of 132° 30′ E. long. To the south and west as yet undetermined. Formerly as far south as Adelaide, and probably ranging east into the Victorian and New South Wales mallee areas.

Seventeen individuals examined.

(3) This was attributed by Thomas to fading, but is not necessarily so.

Although it is very likely that it intergrades with the typical variety in the western portions of its range, this beautiful animal, the most brilliantly coloured of all the marsupials, is so distinct in the type locality that it undoubtedly merits recognition as a subspecies. Knowledge that the eastern forms of *Myrmecobius* are redder than the western, seems to be due primarily to Major Thomas Mitchell, upon whose meagre accounts Waterhouse[4] founded the *nomen nudum, Myrmecobius rufus.*

The name was ignored by Thomas in the catalogue of 1888, although a South Australian specimen was included in the British Museum collection at that time, but was reintroduced by Wood-Jones, who in 1923 published a preliminary description with figures of the skull, of South Australian specimens, from the Murray and from near Adelaide.

In estimating the relation of the central animal to the south-eastern one described by Professor Wood-Jones, I have had to rely for external characters on a single mounted specimen taken in the Murray Scrubs in 1863, and for cranial characters, on two very immature skulls. This material, though insufficient for a proper comparison, seems to me to indicate strongly that in this State the South-eastern and north-western animals are one and the same, and that this form is not specifically separable from that of the karri, jarra and wandoo belts of Western Australia.

The three districts from which specimens have now been examined are widely sundered and show considerable differences in climate and vegetation, but *Myrmecobius,* like its Ornithodelphian analogue *Echidna,* is apparently too strongly committed to a specialized diet, which it finds almost unaltered over the whole of its range, to make any structural response to such changes in physical conditions.

My thanks are due to Professor Wood-Jones and Mr. L. G. Glauert for valuable data and the loan of specimens.

(4) Jardine's Naturalists' Library, vol. xxiv. (1855), p. 149.

GEOLOGICAL NOTES ON THE COCKATOO CREEK AND MOUNT LIEBIG COUNTRY, CENTRAL AUSTRALIA.

By Norman B. Tindale, B.Sc.

[Read April 13, 1933.]

Plate X.

I. INTRODUCTION.

During the fourth and fifth Adelaide University and South Australian Museum Anthropological Expeditions to Central Australia in August of 1931 and 1932, opportunities arose for making brief geological and physiographical notes on the country traversed.

Apart from the work of the members of the Horn Expedition at Haast Bluff Range, the principal geological observers who have made records of the areas discussed herein are Dr. Chas. Chewings (1), who mapped the country from Ellery Creek to Mount Liebig, in 1885, and visited it on three other occasions, and Mr. C. T. Madigan (2), who flew over the country south of Haast Bluff during the course of his extensive researches in the country further east in the MacDonnell Ranges. The country along the Overland Telegraph Line, which we also traversed, has been visited by many geologists and has, therefore, not been referred to in much detail.

Acknowledgments are made of the assistance rendered by the various members of the Expedition, especially to Dr. H. K. Fry, who discussed many of the problems in the field. Dr. Chewings courteously supplied all possible information concerning his observations. The officials of the Property and Survey Branch, Department of the Interior, Canberra (under the supervision of Mr. P. Hossfeld), compiled a map from the then available records for the use of the 1932 Expedition.

We are indebted to Sir Douglas Mawson, Professor of Geology, Adelaide University, and to Mr. C. T. Madigan, for advice and criticism and for the loan of some equipment for the use of the Expeditions. Examination of, and comparative work on, the materials gathered was partly carried out in the Geological Laboratory of the University.

The anthropological researches of the University and Museum were assisted by a grant from the Australian National Research Council.

As in previous accounts the native names have been used, wherever possible, for unnamed physcial features.

II. HANN RANGE TO COCKATOO CREEK, 1931.

The Expedition left Alice Springs early in August and travelled along the main "Darwin track" to Hann Range. The geology of this strip of country, and,

to some extent, of the Reynolds Range, is known, and need not be considered in any great detail. Some particulars that were gathered are noteworthy. Boulders of ilmenitic grit are present on the plain about one quarter of a mile south of Hann Range, and these apparently indicate a junction of the Hann Range conglomerate beds with the underlying Archaean granite gneisses and schists. Dr. Chewings informs me that "greenish-blue slates underlie the Hann Range sandstones, grits, etc. A well was sunk in these slates, 50 or more feet deep, on the south side of and close to the Native Well Gap. One mile south of this Gap is a large area of granite with a waterhole." Specimens have been examined which indicate that this junction extends along the south side of Hann Range and its continuation westward in the Stuart Bluff Range, to beyond West Bluff, and suggests that these hills are the southern marginal beds which form a shallow synclinal fold, the Ngalia Syncline, which varies from eight miles in width at the place where we crossed it to thirty miles further west, and which may extend east and west for some 120 miles, namely, from Hann Range nearly to Mount Davenport. The conglomerate beds at Hann Range consist of a fine arkose sandstone, containing quartz pebbles, up to 10 mm. in diameter. Capping the conglomerate is a medium-grained white sandstone, somewhat felspathic, which is deeply ferruginised where it has been exposed to weathering. Beyond Ryan Well there are three alternative routes to Cockatoo Creek. The particular one followed turns westward along the southern flank of Mount Boothby (Iritjapunja), and then northward to the Woodforde Well, on the Woodforde Creek, at a soakage water called Ilyawa. During the return journey a track passing along the north and east sides of Mount Boothby was followed. The debris in Woodforde Creek, coming down from the north-eastern face of the Reynolds Range, consists of mica-schists and quartz-schist.

From Ilyawa the track goes west for fifteen miles, skirting along the northern flank of the Reynolds Range. This range extends in an almost unbroken line from Mount Airy in the south-east to Mount Gardiner in the north-west. A parallel range running from east of Mount Finnis to beyond Mount Stafford forms the northern side of an almost straight valley, which continues for fifty miles in a north-westerly direction between these two ranges. The Mount Finnis Range is composed of mica-schist, hornblende-schist, and highly metamorphosed quartzite (or quartz schist), whose planes of schistosity dip at a high angle (70°) to the north-east.

Isolated outcrops of gneissic granite are present on the headwaters of the Hanson, which we crossed as we travelled in a north-westerly direction to Rembi Soak, near the southern face of Mount Finnis. A few miles further north-west the track winds up and around schistose outcrops and granite rises to the top of a low divide, the Lander-Hanson divide, which leads across to the headwaters of the Lander Creek. On the return journey a brief opportunity enabled a visit to be made nearly to the crest of the Mount Finnis Range.

The Lander Valley is occupied by a portion of a granite batholith, of which the Mount Finnis Range metamorphic series marks the north-eastern margin. Roof-pendants of schist and augen-gneiss occur. The intruded rocks are apparently highly altered sediments. Quartzites or grits appear to have been ironed out into flat laminae; mica-schist, amphibolites and augen-gneisses are also present, and these are intruded by coarse pegmatite and microgranite dykes. Similar aplites, microgranites and pegmatites occur as dykes in the granite a few miles west, near Lokatja Soak.

Some fifteen miles north-west of Lokatja the track leaves the western bank of the Lander and turns W. 10° S. towards a two-mile-wide wind-gap which appears in the Giles Range. Passing through this a broad vista is obtained of

the headwaters of the Warburton Creek. To the south-east the Mount Reynolds-Mount Thomas Ridge is seen to terminate rather abruptly in Mount Gardiner. A low range, decreasing in importance to the south-east, laps against the north-eastern face of the main Mount Thomas Ridge. To the west of the wind-gap this low range becomes higher and, as the Giles Range, continues W. 30° N. for at least twenty miles. The Warburton Creek cuts through the Giles Range some ten miles to the west.

The beds forming Giles Range are micaceous shales, laminated gritty shales, micaceous sandstones, and coarse quartzites, probably aggregating several thousand feet in thickness. They dip N. 30° E. at an angle of approximately 60°, and maintain a similar strike and dip for at least 15 miles to the north-west. They also extend south-eastwards as far as Mount Thomas. The base of these beds is obscured by alluvium where we crossed them, but a quarter of a mile south-west of the Gap gneissic granite, containing large porphyritic crystals of orthoclase, is present as a peneplaned pavement, and these conditions were noted to continue at intervals thereafter nearly to Coniston Station.

During the return journey the following section of beds, listed in descending order, was examined while climbing to the top of the Giles Range at the Wind-gap, and the thicknesses were then estimated:—

	Feet.
Purple shales with some thin quartzites, etc.	500+
Hard quartzite (forms crest of range)	20
Sandstone	80
Hard quartzite	10
Coarse sandstone	90
Indurated micaceous sandstone	100
Gritty sandstone	100
Micaceous shales	400
Finely laminated gritty shale	50
Shale	50+
Unconformity	
Gneissic granite	

To the north of the main ridge the purple shales gradually die away into the Lander Plain, being supported by some minor harder quartzite beds which were not examined.

The Giles Range Series appears to be a narrow down-faulted block of somewhat metamorphosed sediments younger than the highly metamorphic Archaean rocks intruded by the granite. The course of the Lander down to the Warburton junction appears to mark a fault-line, for everywhere to the north of the line are gneisses and schists of the Archaean metamorphic series.

From the top of the Giles Range, Mounts Denison, Leichhardt, and Stafford appear as massive blocks to the north. Mount Stafford marks the western extremity of the Mount Finnis Range just before it dies away opposite the Lander-Warburton junction.

Coniston Station is situated at the Mamba soakage water on Warburton Creek, in the centre of a wide peneplane. The creek is half a mile wide at the station and the banks are some forty feet high, composed of consolidated river-wash conglomerate and alluvium. The junction of Tower Creek with the main stream is about a mile up-stream from Coniston. The tributary is bringing down dark-blue quartz-schist, muscovite-granite and hard sugary-quartzite boulders and pebbles from the region immediately to the south of the Mount Gardiner-Mount Thomas Range. The contributions of the Warburton, which flows from the south

and south-west, are largely granitic in character, with some quartzites of the type found at Hann Range.

Some six miles south-west of Mamba is Crown Hill, an isolated table-topped hill with a massive horizontally bedded quartzite capping. Crown Hill stands 460 feet above the plain and is an outlier of the Uldirra (or Sliding Hill) Range further south, where the same beds dip, at an angle of 40° southward, beneath the plain. Beyond Crown Hill, on the far southern horizon, is the long line of bluffs that constitute the Stuart Bluff Range. Stuart Bluff Range is cut across at remarkably regular intervals by wide consequent valleys. The Sliding Hill Range (Uldirra) marks the present watershed-divide of the two inland drainage basins represented by the Lander and Lake Bennett depressions.

From Coniston the track goes west to Brooke Soak, crossing Crown Creek after five miles. Debris in this creek consists of pebbles of gneiss, quartzite and sandstone. Low granite outcrops appear at intervals on the plain, and elsewhere that rock is evidently only thinly covered by a mantle of alluvium. Four miles east of Brooke Soak there is a small hill about 100 feet in height composed of vertically-bedded white quartzite and green amphibolite, striking east and west. This appears to be an indurated roof pendant of Archaean metamorphosed sediments. Just west of Brooke Soak are the twin peaks of Mount Treachery, standing about 1,000 feet above the plain (this mount is locally known as Naval Action). The southern side of Mount Treachery is composed of highly metamorphosed sericitic schists; five miles further west similar beds strike a little south of west, and dip northward at 60°. Para-gneiss and highly altered quartzites are present. To the south there is a low massive granite dome, barely denuded of sedimentary covering, which extends for ten miles east and west and is probably at least five miles wide. The track follows a low, narrow plain (cut in schistose rocks), which lies between the granite and the Mount Treachery beds. An unnamed consequent creek drains the northern side of the granite and cuts its way northward through the Mount Treachery Range near this point.

After crossing Inga Creek, which also drains the northern side of this granite region, the track passes a gigantic highly altered white quartzite outcrop, forming an oval hill two hundred feet high and a quarter of a mile long. Soon afterwards it reaches Aknatalya Soakage, on Cockatoo Creek (22° 10′ south lat. x 132° 5′ east long.). A well had just been sunk here, near the site of the native soakage. The Expedition Base-camp was placed on the banks of the creek a hundred yards south-east of a low hill, composed of kyanite schist, which, to the native mind, represents the petrified ancestral kangaroo man of Aknatalya. A hill (situated a mile west of the camp) which is some 400 feet in height is also composed of kyanite schist, striking a little south of west. A mile south of the camp, across a red-soil plain, porphyritic granite, somewhat gneissic in character, outcrops in low domes; further north the plain is composed of schists and para-gneisses. Granite extends beneath the plain and is exposed at intervals to Ponjina, north-west of Quartz Hill (Yaluwa), where futile effort has been made by a prospective station-owner in blasting out a well through 40 feet of it. Rather fresh examples of biotite-granite were secured here. Large black tourmalines are present in quartz-pegmatites in the vicinity, but were not found *in situ*.

The country immediately south of Quartz Hill was visited by one of the Expedition members, who reported that there were low granite outcrops on the plain and that some five miles further south there was a low range with a northern scarp. Viewed from the top at Aknatalya, this ridge was seen to trend away west towards the Treuer Range, and it is evidently identical with the Mount Eclipse Range of Warburton. The granitic country extends westward to beyond Rock Hill. A visit to the low hills five miles north-west of the Base-camp revealed a ridge of para-gneiss, flanked by schists, on the adjacent plain.

III. NOTES ON THE FORMATIONS OF THE HANN RANGE-COCKATOO CREEK AREA.

The following geological series appear to be represented in the area between Hann Range and Cockatoo Creek:—

A. Metamorphic series, of Archaean age.

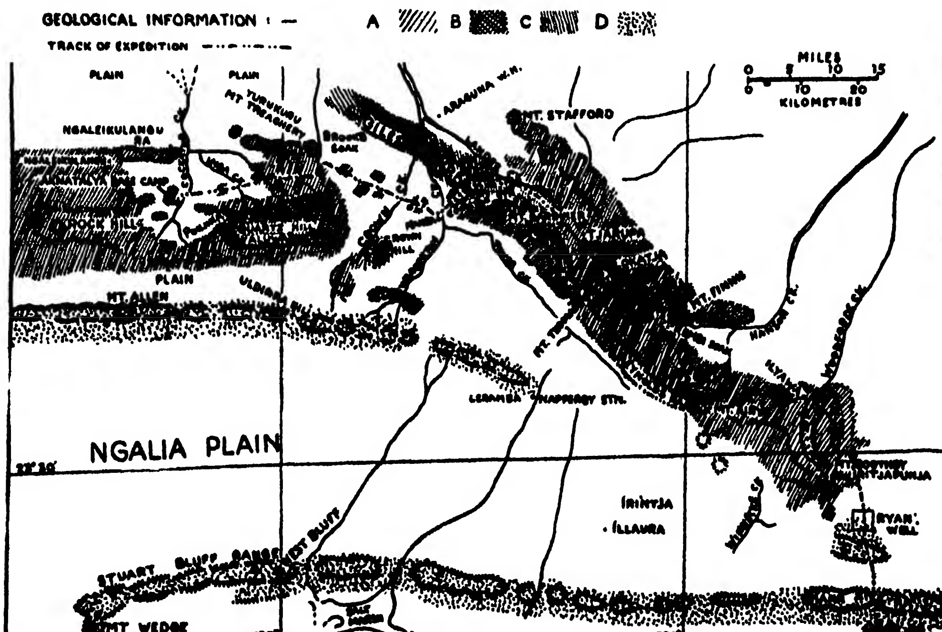
B. Granites intruded into the Archaean rocks.

C. Giles Range series. These are tentatively considered to be of Older Proterozoic Age, and may represent the northern equivalents of the Pertaknurra series as defined by Mawson and Madigan (3) and by Madigan (4).

D. Hann Range-Uldirra Hill-Crown Hill series of unmetamorphosed quartzites, arkose grits and conglomerate.

E. Consolidated grits and recent fluvial deposits of Mamba plain, Ngalia plain, and the Lander Valley.

The grain of the country runs south-east to north-west from Mount Boothby to Mount Thomas, after which it swings around gradually to the west until at Cockatoo Creek the axis is approximately W. 5° S. On a previous journey it was observed that east of the Telegraph Line the trend of the tectonic axis is south-east



through the country near, and to the north of, the Strangways Ranges, where it turns eastward again along the trend of the Hart Range. In a previous paper (5) mention was made of the occurrence of granite stocks and granite-porphyry dykes, on the Archaean plateau of the Waite, Fraser, and Bundey Creeks.

The Archaean metamorphic rocks in the vicinity of the granite intrusions in the Cockatoo Creek area appear to have developed marked peripheral schistosity.

The granite intrusions preceded the formation of the Giles Range beds, for these were laid down on a peneplaned surface of granites, gneisses and schists, in a similar manner to the basal beds of the Mopunja Range 170 miles further east.

Few lithological similarities can be traced between the Giles Range sediments and the Pertaknurra series as seen at Heavitree Gap, but there are similarities with the basal beds of the Mopunja Range, namely, in the presence in both of freely alternating beds of shale, gritty sandstones and quartzites, and in the presence of purplish shales, but they differ in the comparative absence of the felspathic grits in the case of the Giles Range series.

The Hann Range series is less metamorphosed and has been less intensely folded and faulted than the Giles Range series. It may therefore be tentatively suggested that they are younger than the Giles Range and the earliest beds of the Mopunja Range.

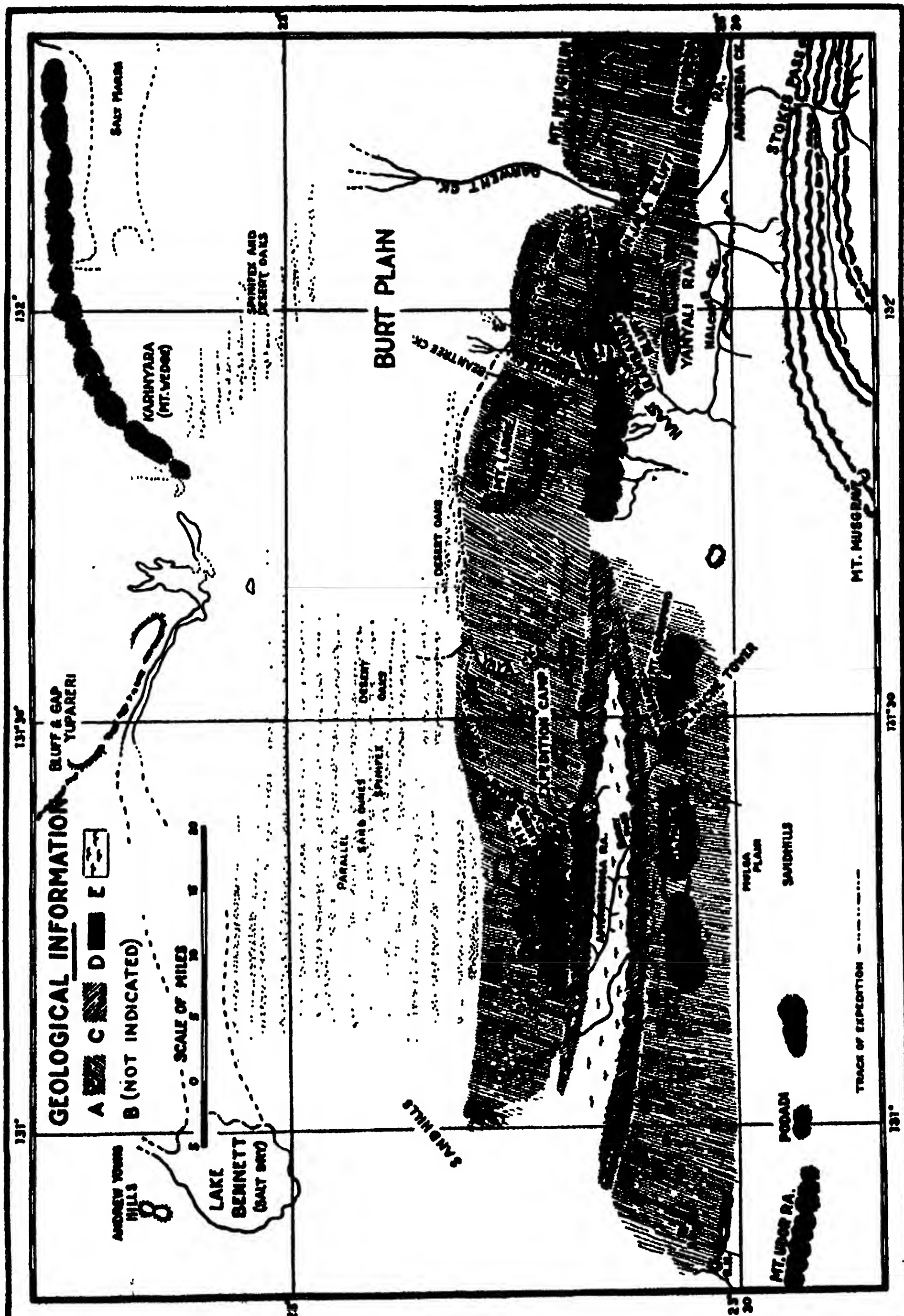
IV. PAINTA SPRINGS TO MOUNT LIEBIG, 1932.

Leaving the Telegraph Line at the top of Alice Springs Pass, we turned westward and skirted along the northern side of the MacDonnell Range. Archaean rocks of the Aruntan complex here rise almost vertically from the level peneplaned Burt Plain, and run due east and west for over a hundred miles. In places where granite forms the northern face of the range the red soil extends right up to the steep face without a very appreciable slope, so that it is possible to drive for miles within a few feet of the rock-face or even to stand with one foot on the flat plain and the other on an almost vertical granite wall. Gneissic granites, intruding hornblende schists, are the predominating rock types. An association of a greenish epidotised siliceous rock (probably an altered sediment) with hornblende-schist is characteristic of the vicinity of Painta Springs, and the two types reappear together over one hundred and fifty miles to the westward, on the northern slopes of Mount Liebig. The schists occur as planed-off surface outcrops on the plain, and in that form extend northward from the steep walls of the main range for many miles. In places they form ridges as in the low Adla Range, which runs parallel to the main range and joints with the Mount Hay Range further west.

A bore recently put down by the Works Department indicates that a considerable thickness of unconsolidated sediments may exist in the eastern portion of the Burt Plain, for, on a site about a mile north of the range, opposite Mount Everard, subartesian water has been obtained, without reaching bed-rock, at a depth of 678 feet. This bore passed through about twenty feet of surface limestone, beneath which were only unconsolidated sands and silts. A bed of argillaceous lignite was met with near the bottom of the well. Dr. Chewings states that the Lower Hanson is a similar valley-like depression, filled with sediments.

After skirting the head-waters of the Charley Creek the track passes north-west across a wide alluvial plain to the Mount Hay Well (and Dam), on Hamilton Downs Station. Here again a depth of about 100 feet of soft sediments, principally arkose sand and silt has been proved. Mount Hay Range is 800 feet above the plain, and runs east and west for more than 25 miles. A low flat-topped shelf, about 50 feet in height, skirts its south-western flank where it is truncated by the wide channel of the Charley Creek. According to Dr. C. Chewings the shelf is composed principally of white calcareous sandstone and limestone and is evidently of fluviatile origin. It is, geologically, quite young—perhaps Pleistocene or Pliocene. It may represent the uppermost portion of the sediments that fill the ancient depressions, or valleys, in which freshwater wells are obtainable over the schist area of the Arunta shield.

West of Mount Hay Well the road crosses a broad flood-plain, swampy in parts, and then returns to the foot of the main range. Near Redbank Station, due south of the Mount Chapple Range, there is a low divide of Archaean schists separating the watersheds of the Charley and Halleem Creeks. Mount Chapple Range strikes west for fifteen miles from the western side of the Charley Creek,



and then veers away to the north-west. Opposite Redbank Station, where a brief examination was possible, the rocks were Archaean gneisses and schists. Mount Chapple is high, standing probably some 1,200 feet above the plateau. After cross-

ing the Halleem, the track continues west-north-west for many miles over a featureless plain, largely covered with dense mulga scrub. The north side of Mount Zeil appears from a distance as a solid mass of gneiss or gneissic-granite, rising abruptly from the flat sandy plain. The Dashwood Creek comes out of the Mount Zeil Range from the south-west as a considerable gum-creek carrying gneiss and schist pebbles and coarse arkose sand. After leaving the Dashwood the track passes closely along the northern face of the Mount Heughlin Range, which also rises steeply from the plain. A noteworthy feature here and at Mount Zeil is the absence of defined drainage from the steep northern slopes. To the north is a vast level mulga-covered plain, extending without a break to central Mount Wedge, forty miles north-west.

A low wind-gap near the western extremity of the Mount Heughlin Range yields a passage to the south side; the paragneiss of this range strikes west and has a plane of schistosity 80° north.

Across the wide detritus filled valley of the Darwent Creek the high Haast Bluff Range stands over 2,000 feet above the plain. It runs east and west and has three principal peaks. Colonel Warburton (6, 7), on May 2, 1873, supposed the eastern one of these peaks to be Haast Bluff, and on July 2, 1873, W. C. Gosse (8) saw the western one and identified it as the mountain which Giles had named. Giles himself seems to have seen the western portion of the range from Mount Tate on September 15, 1872, and named it the Liebig Mountains. Ever since Warburton's and Gosse's time the range has been known as the Haast Bluff Range, the western mountain as Gosse's Haast Bluff and the eastern as Warburton's Haast Bluff. The western summit is the highest and is marked as Haast Bluff on the latest small-scale map (North and Central Australia Pastoral Map, December 11, 1930). In the present account the native names Injala and Ulambaura are used, respectively, for the eastern and central peaks. This is the Belt Range of the Horn Expedition, in which account the three peaks are named, respectively, as Mounts Edward, William, and Francis, but the old name holds sway. From the Mount Heughlin wind-gap the track leads southward for six miles to the Darwent, crossing where low banks and a bar of gneissic rock, with a plane of schistosity 80° N. facilitates a passage across the Darwent Creek. Further down stream the creek flows between vertical walls of alluvium up to thirty feet in height. At the crossing a small tributary from the east brings down gneiss and schist pebbles from the low ranges to the east and south-east. The main creek is loaded with debris, which includes para-gneiss, schist, purplish felspathic grits, fine-grained quartzites, and quartzites containing fragments of undetermined fossil Pelecypods.

An examination of the talus at the base of Injala Bluff, and an ascent of the front of the range to a height of some 800 feet above the plain, showed that the cap on the Injala mountain of the Haast Bluff Range is composed of a considerable thickness (some 500-600 feet) of purplish laminated felspathic quartzite. The quartzite beds dip north at about 30°. Tate and Watt (9) described this considerable and relatively horizontal capping of sandstone and quartzite, and considered it to be of Ordovician age. Chewings (10) regards it as much older. It rests on a massive pedestal of para-gneiss and schists whose plane of schistosity is 65° N. A six feet wide snow-white quartz-felspar pegmatite dyke is a conspicuous feature in the gneisses at the eastern extremity of Injala. The view to the south from this point shows the continuous line of the Mount Musgrave Ridge, or ranges, across the horizon. Viewed from this direction the vertical northern scarp of these steeply dipping Larapintine quartzites, as described by Madigan, closely resembles a vast flat-topped tableland, and it is so described on a recent map. Nearer at hand is Yanyali Ridge, the capping of which, as indicated by Chewings, is a detached segment of the Pertaknurra

quartzite. Beyond Halcomb Creek there appears to be a broad and low shelf about one hundred feet high, which extends nearly to the foot of the Mount Musgrave Ridge. From Injala the track goes north for six miles across claypans and flood-flats of the Darwent Creek, and then turns west-north-west over a wide, shallow sand-plain, studded here and there with low ridges of para-gneiss and schist, with westerly trend. The dip of the plane of schistosity here is less, approximating to 45° N. at the places examined. After crossing the Ulambaura, Hunter, and Bean-tree Creeks (which drain the northern scarp of Haast Bluff Range and spread out and lose themselves on the northern plain), the track skirts the relatively low but extensive Mount Larrie Range, which is principally composed of granitic gneiss. Here the track follows along the crest of the first of a series of sand dunes which run parallel to, and north of, the range.

These low east and west running sandhills are a characteristic physiographical feature of the country for many miles north and for over one hundred miles in an east to west direction. They are approximately one mile apart, and from thirty to fifty feet high, covered with spinifex and low mallee scrub, with desert oaks *(Casuarina Decaesniana)* in patches. The ascent on to the sand ridges is usually gradual; there may or may not be a moving crest of loose sand. The country between them is densely covered with mulga scrub. The dunes form a belt from 15 to 20 miles wide and are succeeded on the northern side by claypans, broken limestone flats, and terraces, indicating a former extension of the terminal drainage basin (Lake Bennett). At its maximum this dry salt lake must have been over one hundred miles long and not less than fifteen wide. At present the drainage into it from the higher country is insufficient to maintain defined channels across the sand barriers. Yaya Creek, which we now approached, is typical of numbers of these flood channels, which fan out and lose themselves in the dunes soon after they leave the schist platforms at the foot of the ranges. The Yaya flows from the northern side of the eastern extension of Amunurunga Range and travels across the northern plain between walls of red soil from twenty to thirty feet high. The bed is choked with coarse sand containing large pebbles and gravel in abundance. Close-grained quartzite pebbles predominate; all are worn and well rounded; pebbles and boulders of gneiss are also present, together with irregular pieces of red limestone-conglomerate.

West of the crossing at Yaya Creek there is a broad red-soil plain covered with mulga scrub. Four or five miles west of Yaya Creek there is an isolated low hill composed of coarse-grained quartz-schist dipping 60° N. This is the northernmost visible extension of the Archaean rocks in the vicinity. The track now veers to the south-west with Mount Liebig forming a prominent teature directly ahead. Low hills of gneissic character become more common but their presence does not seem to impair the regularity, or general direction, of the parallel dunes. The southernmost of these dunes is passed about six miles north of the main Liebig Range. Approaching Mount Liebig the track traverses some six miles of rising ground thinly covered in alluvium; this slope affords excellent exposures for a typical section of the Aruntan metamorphic rocks in this region.

The camp of the Expedition was placed under the shadow of the eastern end of Mount Liebig, on an old native camp, situated about three-quarters of a mile north of the main water on Amunurunga (Mount Liebig Pass) Ridge, and just north of the junction between the Arunta complex and Pertaknurra sedimentary series.

A geological examination of the district proceeded as opportunity offered during intervals in anthropological work. Through the co-operation of various members of the Expedition preliminary samples were brought in from all neighbouring places visited.

V. NOTES ON THE FORMATIONS OF MOUNT LIEBIG AND VICINITY.

Four principal series of rocks were observed in the Mount Liebig district and during the journey from the vicinity of Painta Springs.

A. *Arunta Complex of Archaean Age.*—These rocks consist largely of para-gneisses, amphibolites and quartz schists. An extensive suite of specimens was collected and are available for study. Quartz schists are common: epidotised siliceous sediments, amphibolites, and augen-gneisses are represented in considerable variety.

B. *Granites* and associated pegmatite dykes intruded into the rocks of the Arunta Complex. The granite of the Mount Liebig area is not well developed, appearing in isolated stocks at wide intervals. The tectonic axes are due east and west from the vicinity of Mount Zeil to beyond Mount Liebig. A few aplitic dykes and acid pegmatites are present.

C. *The Amunurunga Range Series.*—This series consists of quartzites, sandstones, conglomerates and highly altered shales, approximately 10,000 feet in thickness (estimated). As first indicated by Chewings, they are downfolded into the Aruntan rocks and occupy a synclinal basin overfolded towards the south. West of Mount Liebig the limbs of this fold diverge slightly and gradually dip beneath the plain. To the eastward they converge and the northern limb approaches the southern.

An examination of the sediments of Amunurunga Range was made at the Amunurunga Pass, five miles east of Mount Liebig summit. The last-named summit is situated on a much higher range which runs parallel to the Amunurunga Range some two miles further north.

The principal beds noted at Amunurunga Pass and the thicknesses estimated after rough pacing were, in descending order:—

	Feet.
Yellow sandstone	2,500
Upper (white) quartzite	2,600
Lower (fine-grained grey) quartzite	1,900
Metamorphosed shale	700
Grit Beds	800
Basal conglomerates and conglomeratic grits	1,500
Unconformity	
Arunta Complex	

The basal conglomerate contains rolled-out quartz pebbles up to 20 cm. in diameter. The conglomerate is succeeded by grit beds containing occasional pebbles. These beds have all been metamorphosed and are penetrated by a network of quartz veins from 1-5 mm. wide.

The metamorphosed shales which succeed them weather out as a trough along the northern face of the quartzite ridge, the trough being due to the differential erosion between the grits and shales, and the intensely hard lower quartzite, here overfolded to such an extent as to form a protective capping to the sandstones which are stratigraphically above them. Watercourses have cut narrow and deep gorges at regular intervals across this hard quartzite, and it is in these narrow clefts that the changing dip is best seen. In addition to the major folds individual beds are intensely folded, the weathering of these has revealed remarkable examples of multiple overfolding. Wave ripple-marks are a feature of the fine-grained quartzite; owing to the over-turning of the beds they are present as moulds on the faces of the rocks.

The upper quartzites are slightly less compact than the lower ones and are succeeded by a great thickness of reddish-yellow sandstone composed of well-rounded grains of remarkably even grade.

Limestones are conspicuous by their absence, but some may be concealed under the wide alluvium-filled valley immediately to the south. On the ground of the lithological resemblances between these Amunurunga beds and the Heavitree Gap beds (notably the presence of the dense white quartzite and associated beds, which resemble the quartzite of Heavitree Gap) they are equated with the Pertaknurra Series (Madigan's Older Proterozoic).

D. *Mount Liebig Capping Beds.*—The beds capping Mount Liebig dip N. 5° W. at an angle of approximately 20 to 30° from the horizon; they rest unconformably on the upturned edges of para-gneiss, amphibolites, and quartz schists, of which the northern foothills are composed.

The explorer Gosse (8) apparently noticed these capping beds when he climbed Mount Liebig in 1873. He described the Mount as composed of basalt and gneiss, and sandstone, with strike E. and dip 14° S. It seems likely that 14° S. is an error for 14° N. in the dip of the capping beds only. Chewings did not have the opportunity of examining them.

At a point a quarter of a mile east of the summit cairn, erected by Gosse, the capping beds, in descending order, are estimated as follows:—

	Feet.
Felspathic quartzite	20+
Finely laminated sandstone	80
Laminated felspathic purple grit	200
Gritty conglomerate	200
Unconformity	
Arunta complex	

The basal conglomerate is not a strong feature. It shows undeformed quartz pebbles up to 4 cm. in diameter imbedded in a coarse grit composed of quartz and kaolinised felspar. Some pebbles, apparently weathered out of this basal bed, which were picked up on the scree below the junction with the metamorphic rocks, are composed of quartz schist.

The conglomerate beds merge upwards into a purplish-coloured, laminated, felspathic grit. The laminae consist of regular varve-like alternations of coarser purplish grits and fine-grained light-coloured sand, almost of silt grade. The coarse bands have an average thickness of 7 mm., the usual range being from 4 to 15 mm. The finer-grained laminae are more variable and show minor banding of very fine-grained constituents. They range from 3-20 mm. in thickness with an average of 10 mm.; the minor banding is of the order of 1 mm.

The possibility should be borne in mind that the presence of these varved sediments may indicate fluvio-glacial conditions during the formation of these beds.

The series, as a whole, shows no sign of deformation or metamorphism; a few thin quartz veins are apparent, these frequently bear minute crystals of iron pyrites. In this they are in strong contrast with the Amunurunga Range beds, the basal beds of which are honeycombed by a network of such veins.

The purple grits merge almost insensibly into fine-grained sandstones of a lighter purplish colour. The varve-like banding continues but the coarser bands are narrow, ranging from 1-4 mm. in thickness. The finer bands are definitely of silt grade and range from 3-15 mm. in thickness. They also show traces of the above-mentioned minor lamination.

Near the summit of Mount Liebig the beds are of white quartzite, superficially hardened by secondary silicification.

The purple-coloured capping-beds of the eastern end of Haast Bluff Range are similar in character to the Mount Liebig ones and show identical lamination. Their strike and dip is also similar. It is evident at Mount Liebig that marks of greater disturbance, higher state of metamorphism, and nearly vertical disposition

of the (Older Proterozoic) sediments that form the southern half of the Liebig mountain-mass (Amunurunga Range) as compared with the capping beds, show such strong lithological and structural contrasts and the beds of each present such a wide angle of discordance that they must belong to two different series, separated by a vast hiatus in geological time.

South of Berry Pass similar beds to the Liebig capping beds have been described by Chewings as forming Mounts Palmer, Crawford, Peculiar, and Blanche Tower. At these places they are practically horizontally bedded. They stand on Archaean rock in a similar manner to the Mount Liebig and Injala Bluff occurrences.

These mountains and the Liebig capping are survivors of an extensive series, of which further traces may be expected when the table-topped hills west and north-west of Mount Liebig are examined.

E. *Tertiary to Recent.*—Under this somewhat indefinite classification may be placed the sand dunes of Burt Plain and the limestones now forming in the occasional waterholes through the agency of lime-depositing *Chara*-like algae. The red limestone conglomerate washed down Yaya Creek may also be tentatively classified here. Extensive calcareous silt deposits are present on the former terraces of Lake Bennett. Transported fragments of this white argillaceous limestone are plentiful in native camps. According to Mr. T. Strehlow, the present shores of Lake Bennett are covered with salt deposits and sun-baked mud.

References Cited.

1. Chewings, C.—Sources of the Finke River, *pamphlet*, Adelaide, 1886.
2. Madigan, C. T.—Geographical Journal, vol. lxxviii., 1931, pp. 417-433.
3. Mawson, Sir Douglas, and C. T. Madigan—Quart. Journ. Geolog. Soc., vol. lxxxvi., 1930, pp. 415-428.
4. Madigan, C. T.—Geology of the Western MacDonnell Ranges, Central Australia. Quart. Journ. Geolog. Soc., vol. lxxxviii., 1932, pp. 672-711.
5. Tindale, N. B.—Trans. Roy. Soc. South Aust., vol. lv., 1931, pp. 31-38.
6. Warburton, P. E.—Journey Across the Western Interior of Australia. London, 1875.
7. Warburton, P. E.—South Australia:—Parliamentary Paper, 28, 1875, map.
8. Gosse, W. C.—South Australia:—Parliamentary Paper, 48, 1874, pp. 1-23, and map.
9. Tate, R., and J. A. Watt—Report on . . . Horn Scientific Expedition. General Geology, Part 3. London, 1896.
10. Chewings, C.—Trans. Roy. Soc. South Aust., vol. lii., 1928, pp. 62-81.

EXPLANATION OF PLATE X.

Fig. 1. View north-west from the summit of Mount Liebig: The northern foothills composed of Aruntan gneisses and schists with the sandhill-covered Burt Plain beyond.

Fig. 2. Amunurunga Range, looking south-west from the summit of Mount Liebig. Basal grey quartzite of the Amunurunga Range Series appears as wall in middle distance. The junction with the Aruntan gneisses is at about the middle of the low foreground. Mounts Palmer and Peculiar on the skyline; Mount Liebig Capping Beds in extreme right foreground.

Fig. 3. Mount Liebig from the south-east: Vertical southern scarp of Capping Beds resting on Aruntan gneiss and schist platform. Junction of Aruntan and Amunurunga Range series in middle distance. The grey quartzite wall of latter series in left foreground.

ABSTRACT OF THE PROCEEDINGS

OF THE

ROYAL SOCIETY OF SOUTH AUSTRALIA

(Incorporated).

FOR THE YEAR FROM NOVEMBER 1, 1932, TO OCTOBER 31, 1933.

ORDINARY MEETING, NOVEMBER 10, 1932.

The President (Professor J. A. Prescott) in the chair, and 21 Members were present.

Minutes of the Annual Meeting, held October 13, 1932, were read and confirmed.

Apologies were received from the Rev. N. H. Louwyck and Mr. J. H. Gosse.

The formal resignation as Treasurer of the Society was received from Mr. B. S. Roach. The President expressed regret at the decision of Mr. Roach. It was moved by Professor J. Burton Cleland, seconded by Mr. J. M. Black and carried, that the resignation be received with sincere regret.

The President then called for nominations for the office of Treasurer. Professor T. Harvey Johnston moved, and Mr. W. J. Kimber seconded, that Dr. Chas. Fenner be invited to act as Treasurer. There being no other nominations, the President declared Dr. Chas. Fenner elected, if willing to act.

Dr. Chas. Fenner intimated that he accepted with pleasure the invitation extended to him to fill this important office.

PAPER—

"The Dead Rivers of South Australia, Part II.," by Professor Walter Howchin, F.G.S. Dr. Chas. Fenner, Dr. L. Keith Ward, and the President took part in the discussion of the paper.

EXHIBITS—

Mr. B. C. Cotton exhibited some fossil shells which had been recently presented to the S.A. Museum by Mr. W. J. Kimber.

Mr. A. G. Edquist exhibited a bowl of poppy blossoms which have originated as garden varieties in his garden at Glenelg. These blossoms, of wonderful size, colour and form, are the result of hybridization. Some of them appeared in this world for the first time this year.

Mr. W. J. Kimber exhibited some fossil shells from a well 80 feet deep at Campbelltown, where there is a large deposit of them, including at least three species of cephalopods, casts of *Cardium*, foraminifera, and fragments of lignite.

Professor J. Burton Cleland read a note on behalf of Dr. A. M. Morgan, who reported that in May, four years ago, he placed black coloured fruits of *Loranthus exocarpi*, parasite on *Lagunaria Patersoni*, on branches of oleander. Some of these grew and flowered sparingly in the third year, and vigorously in the fourth year (1932). The black fruits planted yielded some plants with yellow and green flowers and red fruits, and some with red and green flowers and black fruits like the original.

The President exhibited some aerial photographs of part of the Murray River in the region of Berri, which had been taken by the Royal Australian Air Force. Also a stereoscopic aerial photograph of part of the Ninety Mile Desert.

Dr. L. Keith Ward gave an interesting account of the occurrence of occluded gases occuring in various rocks in South Australia, which are released during the process of boring when carried out under a head of water. His remarks were illustrated by a number of lantern slides.

Ordinary Meeting, April 13, 1933.

The President (Professor J. A. Prescott) in the chair and 31 Members were present.

Minutes of the Ordinary Meeting, held November 10, 1932, were read and confirmed.

Apologies were received from Rev. N. H. Louwyck, Dr. James Davidson, Mr. A. G. Paul, and Mr. J. H. Gosse.

The President extended a hearty welcome to Sir T. Edgeworth David, an Honorary Fellow of the Society, and the third recipient of the Müeller Medal, and invited Sir Edgeworth to enlighten the Members on the origin of the medal, and the circumstances connected with the award having been made to Mr. J. M. Black.

Sir Edgeworth David thanked the President for the welcome extended to him, and then gave a brief resumé of the history of the Müeller Medal, and the reason why the award had been made to Mr. Black at the last meeting of the A.N.Z.A.A.S. in Sydney.

The President, in making the presentation, said:—"It is my privilege this evening to present to Mr. J. M. Black, our distinguished Vice-President, the Müeller Memorial Medal of the Australian and New Zealand Association for the Advancement of Science, a privilege and welcome task which I have been asked to undertake on behalf of Sir Herbert Murray, the President of the Association. I have no need to remind Members of the services to botanical science in Australia which have been rendered by Mr. Black. His "Flora of South Australia" has become a standard and indispensable work of reference to all botanical workers in the southern areas of Australia, and we have ourselves honoured him through our own Verco Medal. The Müeller Medal was founded in 1902 and was first awarded in 1904. It is awarded in recognition of 'Important contributions to Anthropological, Botanical, Geological or Zoological Science, published originally within His Majesty's Dominions, preference being always given to work having special reference to Australia.' Mr. Black is the fourth Fellow of this Society to receive the medal, previous awards having been to Professor Walter Howchin (1913), Professor Wood-Jones (1926) and to Sir Douglas Mawson (1930). Thirteen medals on twelve occasions have been awarded. We are proud of the fact that Mr. Black is one of our Fellows, and I hope he will accept with it our heartiest congratulations and best wishes."

Mr. J. M. Black, in acknowledgment, thanked Sir Edgeworth David and the President for their kind remarks, and referred to the increased interest taken in Botany in South Australia at the present time compared with 20 or 30 years ago, and the valuable collections which had recently been made by botanists and plant lovers in various districts.

Nominations as Fellows.—Mark Ledingham Mitchell, Lecturer, Fitzroy Terrace, Prospect; George H. Clarke, B.Sc., Lecturer in Botany, Roseworthy Agricultural College; Alfred William Kleeman, 12 Ningana Avenue, King's Park; Michael Schneider, M.B., B.S., Medical Practitioner, 175 North Terrace, Adelaide; Thomas Alfred Barnes, B.Sc., Student, 13 Leah Street, Forestville; Kathleen de Brett Magarey, B.A., B.Sc., Teacher, 38 Winchester Street, Malvern; Herbert Womersley, F.E.S., A.L.S., Entomologist, S.A. Museum, and 36 Wattle Street, Fullarton Estate.

Papers—

"Inflammable Gases Occluded in Pre-Palaeozoic Rocks of S.A.," by L. Keith Ward, B.A., B.E., D.Sc. Sir T. Edgeworth David and Mr. C. T. Madigan discussed various points in connection with the paper. The President thanked Dr. Ward for giving this Society the privilege of printing his important paper.

"Geological Notes of the Cockatoo Creek and Mount Liebig Country, Central Australia," by Norman B. Tindale. The following Members took part in the discussion:—Dr. C. Chewings, Mr. C. T. Madigan, Dr. L. Keith Ward, and Dr. Chas. Fenner.

Exhibits—

Mr. E. H. Ising exhibited *Loranthus miraculosus* Miq., var. *Melaleucae* Tate, and said this was the second record of the occurrence of the order Loranthaceae on Kangaroo Island. It was collected by the exhibitor in 1922 and found growing on *Melaleuca*, sp., which was situated on the edge of a salt lagoon at MacGillivray, about 10 miles south of Kingscote. This mistletoe has only been observed on *Melaleuca* species, two of which, *M. pauperiflora* and *M. parviflora*, are recorded in the Flora of South Australia, p. 171, where also the distribution on the mainland is shown to be the southern districts, chiefly along the coast, Eyre Peninsula and west to Fowler's Bay, Murray Lands, and the South-East. No representatives of the order Loranthaceae have yet been found in Tasmania. The above variety appears to be endemic to South Australia.

Ordinary Meeting, May 11, 1933.

The President (Professor J. A. Prescott) in the chair and 34 members and visitors were present.

Minutes of the Ordinary Meeting, held April 13, 1933, were read and confirmed.

An apology was received from Mr. C. T. Madigan.

The President extended a welcome to Mr. Chalmers and his daughter from MacDonnell Downs, Central Australia, and Mr. Koehncke, as visitors.

The President then drew the attention of the Members to the loss sustained by the Society in the death of Mr. W. W. Weidenbach. On the motion of Dr. L. Keith Ward, the Society recorded its appreciation of the value of the work of the late Mr. Weidenbach, and its regret at his passing. Mr. Weidenbach left a fine record of work as a geological draughtsman, and the many maps drawn by him gave evidence of his fine artistic sense as well as of his sound knowledge of structural geology. He spared no effort to attain the maximum degree of accuracy in all that he did, and this meticulous care enhanced the value of all the work carried out by him. Mr. Weidenbach had a thorough knowledge of mining and the occurrence of underground water, and was better able than most to think in three dimensions. The President asked those present to indicate their approval of the motion by standing for a moment in silence.

Nomination as Fellow.—Allan Donald Service, Chemist, c/o Colonial Sugar Refinery, Glanville.

Election as Fellows.—Mark Ledingham Mitchell; George H. Clarke, B.Sc.; Alfred William Kleeman; Michael Schneider, M.B., B.S.; Thomas Alfred Barnes, B.Sc.; Kathleen de Brett Magarey, B.A., B.Sc.; Herbert Womersley, F.E.S., A.L.S.

A ballot was taken and the above-named were declared elected. Mr. Clarke and Mr. Womersley, being present, were welcomed as Fellows by the President.

Lecture—

Mr. H. M. Hale and Professor T. Harvey Johnston delivered an exceptionally interesting and instructive lecture on "Australian Water Animals and

their Shift for a Living." Mr. Hale illustrated his remarks with a very fine series of lantern slides and a number of specimens. Mr. W. H. Selway and Dr. L. Keith Ward discussed various points in connection with the lecture. The President expressed the thanks and gratitude of the Members to Mr. Hale and Professor Harvey Johnston for their very interesting lectures.

Exhibits—

Mr. N. B. Tindale exhibited a number of geological specimens collected by him in Central Australia, and said that these should have been brought forward at the last meeting to illustrate his remarks when presenting his paper.

Miss Nellie Woods exhibited a series of clover, ranging from the normal three-leaf to the perfect five-leaf, which had been collected in the garden of her home in the hills, and remarked that the only period of the year that the perfect five-leaf clover had been found by her was at the present time. Miss Woods asked if any Botanist could inform her if this range was due to cultivation.

Professor J. Burton Cleland showed a collection of seeds of plants used by the natives of Central Australia for food purposes. These had been collected by Miss Jess Chalmers of MacDonnell Downs, 160 miles north-eastward of Alice Springs. The seeds were winnowed by the natives, and included a number of grass seeds, acacia seeds, and the minute seeds of *Chenopodium rhadinostachyum* and of *Portulaca oleracea*. Some of these seeds had been given to Mr. Greaves, Director of the Botanic Gardens, and pot plants were shown of the *Chenopodium* and of *Acacia aneura* (mulga) and *A. Kempeana* (witchetty bush). He also showed pot plants of a small *Nicotiana* growing on the sandhills in Central Australia, and used by the natives for chewing purposes, and for comparison with this, a stout form of *Nicotiana suaveolens* grown from seed from Hallett's Cove. Both specimens of *Nicotiana* had been grown by the Director of the Botanic Gardens. For chewing purposes the natives prefer the large *Nicotiana excelsior* growing amongst rocks, to the sandhills species.

Ordinary Meeting, June 8, 1933.

The President (Professor J. A. Prescott) in the chair and 28 Fellows and visitors were present.

Minutes of the Ordinary Meeting, held May 11, 1933, were read and confirmed.

The President announced that on the next lecture evening the subject would be "Modern Genetics."

Nomination as Fellow.—Harold Greaves, Director, Botanic Garden, Adelaide.

Election of Fellow.—Allan Donald Service, Chemist.

A ballot was taken and Mr. Service was declared elected, and, being present, was then welcomed by the President who also extended a welcome to Miss Magarey and any other new Fellows who may be present.

Papers—

"A Preliminary Account of the *Collembola-Arthropleona of Australia*," by H. Womersley, F.E.S., A.L.S. In the discussion that followed Mr. W. J. Kimber remarked that these insects attacked celery, and as large quantities of this vegetable were exported to the Eastern States from South Australia, it was a matter of great importance that it be kept in check. Professor J. Burton Cleland and the President also spoke.

"Notes on the Flora of South Australia, with a Description of a New Species, No. 1," by E. H. Ising. The paper was concerned with species of *Bassia*, one of which was new and was named after Mr. J. M. Black, Senior Vice-President, to honour him for his botanical work in this State. The species was

called *Bassia Blackiana*. Mr. J. M. Black, Dr. Chas. Fenner, Professor J. Burton Cleland and the President congratulated the author on his work.

"Two New Danthonias," by A. B. Cashmore (communicated by J. M. Black, A.L.S.). The species were named *Danthonia Duttoniana* and *D. Richardsonii* and were both of economic importance. The President pointed out the value of the paper, which clearly defined two grasses which had been known but not described.

"A Revision of the Eurymelini (Homoptera Bythoscopidae)," by J. W. Evans, M.A.

Exhibits—

Professor J. Burton Cleland exhibited a specimen of *Loranthus pendulus*, which was parasitic on the golden wattle *Acacia pycnantha* and also on *Acacia rhetinodes*, and *Loranthus Preissii* growing on *Acacia rhetinodes* and *A. melanoxylon* and *Loranthus Exocarpi* growing on *L. Preissii*. All the specimens were collected at Tweedvale on June 5, 1933.

Mr. J. M. Black exhibited some botanical specimens sent by Mrs. V. Petherick, Naracoorte, and included *Epacris impressa* (heath) and *Leucopogon ericoides*, which was a more northerly site than had been previously recorded.

Ordinary Meeting, July 13, 1933.

The President (Professor J. A. Prescott) in the chair and 28 Members were present.

Minutes of the Ordinary Meeting, held June 8, 1933, were read and confirmed.

The president read a draft of the clauses recommended by the Council in connection with the constitution of the Endowment and Scientific Research Fund.

Dr. Chas. Fenner then moved a notice of motion that the recommendation of the Council be adopted. Seconded by Dr. T. D. Campbell.

Professor T. Harvey Johnston moved, and Mr. J. M. Black seconded, that the discussion of the notice of motion be deferred until the Ordinary Meeting to be held in September. Carried.

It was then moved by Mr. O. A. Glastonbury, seconded by Dr. Chas. Fenner, that the full text of the notice of motion be circularized. Carried.

Nomination as Fellows.—James Hugo Gray, M.B., B.S., Medical Practitioner, Adelaide Hospital; David Hugh Le Messurier, B.Sc., Student, 133 Mills Terrace, North Adelaide.

The President announced that the Council has received the resignation of Mr. A. M. Ludbrook, as Librarian, and moved that the appreciation of the Fellows be extended to Mr. Ludbrook for his 20 years' service, and that the thanks of the Society be recorded in the Minutes. Dr. Chas. Fenner, in seconding the motion, referred to the valuable work performed by Mr. Ludbrook during his tenure of office. The motion was carried with acclamation.

Paper—

"Distribution of Myoporaceae in Central Australia," by T. T. Colquhoun, M.Sc. The paper was presented by Professor J. Burton Cleland, who apologized for the absence of the author, and said that the paper was a technical one. The President congratulated the author on his contribution.

Exhibits—

The President exhibited a coloured plate of Australian soil types, the colour work of which was very good and true to the originals. The printing had been done in Leipsig.

Mr. B. C. Cotton exhibited a number of shells from the Museum collection showing three kinds of design. The tendency for the whorls to separate causing the spiral to become elongate. The occurrence of forms, where the shell turns to the left instead of the right. Also malformation due to breakages.

Dr. Chas. Fenner exhibited fulgurites collected from the sandhills at Port Noarlunga, and from Morton's Bay, Queensland.

Dr. T. D. Campbell exhibited the heel bone of an Aborigine in which is embedded the tooth of a shark. Apparently the native had been seized by the foot by a shark while swimming. It seems likely that the native must have died soon after, otherwise pathologic changes in the bone surrounding the tooth would have been apparent.

Mr. H. H. Finlayson exhibited panoramic photographs of the north face of Ayers Rock, and the west face of Mount Olga, taken by him in February, 1932. He stated that the difficulties of conveying an adequate idea of the impressiveness of these two features in photographs was very considerable, owing to their great lateral extent, and the absence of convenient vantage points commanding the two aspects mentioned, at a suitable distance, to include the whole in one exposure. The pictures shown were obtained by making three exposures at fairly close range and joining the three resulting films. Though the results were not technically good, he considered that the method gave a truer record of these remarkable rocks than most of those which had been published. He also exhibited specimens of the rocks from the same outcrops. The President congratulated Mr. Finlayson on obtaining such good pictures of these two natural features.

Mr. G. H. Clarke exhibited *Loranthus Preissii* growing on *Cassia Sturtii* (from near Roseworthy College). *Loranthus Exocarpi* growing on *Casuarina stricta* (from Cockatoo Valley). *Loranthus Exocarpi* growing on *Loranthus Miquelii,* the latter in turn parasitising *Eucalyptus rostrata* (from Cockatoo Valley.) An *Oxalis,* possibly a mutant form of *Oxalis cernua* (Soursob) which appears each year in one of the paddocks at Roseworthy College. It differs from *O. cernua,* mainly in the hairiness of the leaflets, the flattened petioles, the shorter and somewhat flattened peduncles, and in the relative lengths of style and stamens. In the form exhibited the stigmas occupy the middle position, midway between the inner and outer stamens. In certain other plants the styles are long and the stigmas are at the uppermost level, the inner and outer stamens occupying the middle and lowest levels, respectively. A pathological condition of *Sonchus oleraceus,* suggestive of the "Witches Brooms" formed by certain plants as a result of parasitic infection; in this case the condition is probably due to a high concentration of salts in the soil. The plants have been observed to show this abnormality only in two situations, both known to be of high saline concentration. At a given level the plant endeavours to form the flower head. It produces an involucre and the primordia of florets. Some of the latter may develop a corolla, and in some cases a whorl of stamens, but are unable to produce carpels. In lieu of carpels, the floral axes grow erect into a series of peduncles and the whole process is repeated at a higher level, leading to the corymbose branching structure seen in the specimen.

Mr. Herbert M. Hale exhibited the following specimens:—The cast of a Mirror Dory *(Zenopsis nebulosus)* which was taken from a specimen recently caught off Kangaroo Island. The specimen exhibited constitutes the first record of the species in South Australian waters. It occurs off the coasts of Japan and the eastern coast of Australia. He also showed various reptilian monstrosities, including multiple tails, double headedness, siamese twins, albinism and duplication of limbs.

Professor J. Burton Cleland read the following extract from a despatch of Governor Gipps from Sydney, dated November 30, 1840, recently quoted by

Mr. J. F. Campbell in the Journal and Proceedings of the Royal Australian Historical Society (xvii., pt. vi., 1933, p. 339), which shows that over 90 years ago the advantage of placing grain in hermetically sealed silos had been discovered. During the last years of the Great War, at the time of the mouse plague, the same measures were adopted with success in Australia:—"The quantity of wheat now stored in the underground granaries, or silos, which were excavated last year at Cockatoo Island, is 20,000 bushels, but additional silos are in progress, and if the price of wheat continues as low as it now is in Sydney, I propose to increase the Government stores to any amount not exceeding 100,000 bushels. The silos, of which I have spoken, are excavations in the solid (sandstone) rock shaped like a large bottle, and capable of holding from 3,000 to 5,000 bushels each. Being hermetically sealed, grain of any kind may be preserved in them for years. The total exclusion of air also entirely destroys any weevil or other insects that may be in the grain at the time it is placed in the silos. This we found to be the case in the wheat which was received from India. It was much infected with weevil when put into the silos in December, 1839, but there was not a living insect in it of any kind when taken again from the silos in March last."

Ordinary Meeting, August 10, 1933.

The President (Professor J. A. Prescott) in the chair and 39 Members and Visitors were present.

Minutes of the Ordinary Meetnig, held July 13, 1933, were read and confirmed.

The President extended a welcome to Sir Douglas Mawson on his return from abroad, and also to Mr. Southam, the Editor of the Royal Society of Western Australia.

The President noted the recent death of Mr. M. S. Hawker, a Fellow of this Society, famous as a South Australian Pastoralist, and who was associated with the Fauna and Flora Board of South Australia; and then announced that the greatest personal loss the Society had suffered was the passing of Sir Joseph Verco. Professor Prescott gave a brief resumé of Sir Joseph's years of activities and services to the Society, and informed the Members that an obituary notice would be prepared and published in the Transactions of the Society. He asked those present to stand in silence for a few seconds as an expression of deepest sympathy.

Nomination as Fellow.—Herbert Clifton Hosking, B.A., Chief Inspector of Schools, S.A., 24 Northcote Terrace, Gilberton.

Election of Fellows.—Harold Greaves, Director, Botanic Garden, Adelaide; James Hugo Gray, M.B., B.S., Adelaide Hospital; David Hugh Le Messurier, B.Sc., Student, 133 Mills Terrace, North Adelaide. A ballot was taken and the President declared them duly elected.

Papers—

"A Preliminary Account of the Bdellidae (Snout Mites) of Australia," by H. Womersley, A.L.S., F.E.S. The President congratulated Mr. Womersley on presenting an important paper on a new group of insects to this Society.

"Contributions to the Orchidology of Australia," by R. S. Rogers, M.A., M.D., F.L.S.

The President then informed the Fellows that, owing to the death of Sir Joseph Verco, it was necessary, according to the Rules and By-Laws of the Society, to elect another Member on the Council. Sir Douglas Mawson nominated Dr. L. Keith Ward. The nomination was supported by Professor Walter Howchin. There being no other nominations, the President declared Dr. Ward duly elected.

A very instructive and interesting lecture was delivered by Dr. Ivan F. Phipps on "Heredity as we see it today," which was illustrated with a number of lantern slides. The following took part in the discussion which followed:—Mr. J. M. Black, Mr. W. H. Selway, and Dr. W. Christie. The President expressed the thanks of the Members to Dr. Phipps for his fine exposition of a very difficult but interesting subject.

Ordinary Meeting, September 14, 1933.

The Senior Vice-President (Mr. J. M. Black) occupied the chair and 24 Members were present.

Minutes of the Ordinary Meeting, held on August 10, 1933, were read and confirmed.

The following Notice of Motion was then moved by Dr. Chas. Fenner, seconded by Mr. C. T. Madigan:—

(a) That the Fund as set out on pages 212 and 213 of the Transactions and Proceedings, vol. lvi., 1932, be entitled the Endowment Fund.

(b) That from the interest therefrom each year a sum not exceeding £20 (as the Council may from time to time determine) be paid into a separate account in the Savings Bank of S.A., which with its accumulated interest will be entitled the "Royal Society of S.A., Inc., Research Fund," and which will be devoted to grants in aid of research work by members of the Society for work done in Australia.

(c) That the balance of the interest from the Endowment Fund be utilized for the cost of printing and publication of the Transactions and Proceedings of the Society, and other general purposes.

(d) That additions to the Endowment Fund may be made by the Council from time to time from the general revenue of the Society.

(e) That applications for grants in aid of research shall set out in writing the nature of the work to be attempted and that all such grants shall be considered and reported on to the Council by a Research Grants Committee, consisting of the President, Secretary, Treasurer, and one other Member nominated by the Council from time to time.

(f) That these clauses be inserted in the By-Laws of the Society.

Professor T. Harvey Johnston moved as an amendment that sections *b, c, d, e,* and *f,* be struck out, seconded by Sir Douglas Mawson. The amendment was put to the meeting and declared lost. Professor Walter Howchin moved as an amendment that further consideration should be postponed until the next meeting, seconded by Mr. W. H. Selway. The amendment was put to the meeting and declared lost.

The original motion was then put to the meeting and declared carried.

The Chairman extended a welcome to Mr. Le Messurier as a new Fellow.

Nominations as Fellows.—Allan Walkley, B.Sc., B.A., Ph.D., Research Chemist, Waite Agricultural Research Institute, and 8 Ralston Grove, Mrytle Bank; Joan Eileen Walkley, B.Sc. (Lon.), 8 Ralston Grove, Myrtle Bank.

Papers—

"The Ecology of the Aborigines of Central Australia, Botanical Notes," by Professors J. Burton Cleland, M.D., and T. Harvey Johnston.

"Tantanoola Caves, Geological and Physiographical Notes," by N. B. Tindale.

"On *Mastacomys fuscus*," by H. H. Finlayson.

"On some Acarina from Australia and South Africa," by H. Womersley, F.E.S., A.L.S.

The Chairman announced that applications were being called for the position of Curator of the Tasmanian Museum.

Professor T. Harvey Johnston then put forward a suggestion for the consideration of the Council, that a portrait of the late Sir Joseph C. Verco should be placed on the walls of the Society's Rooms.

ANNUAL MEETING, OCTOBER 12, 1933.

The President (Professor J. A. Prescott) in the chair and 29 Members were present.

Minutes of the Ordinary Meeting, held September 14, 1933, were read and confirmed.

Apologies were received from Mr. C. T. Madigan and Mr. F. C. Martin.

The President read a communication received from the Secretary, Tasmanian Museum, asking for subscriptions toward the Clive Lord Memorial Fund.

ELECTION OF FELLOWS.—Herbert Clifton Hosking, B.A., Chief Inspector of Schools, 24 Northcote Terrace, Gilberton; Allan Walkley, B.Sc., B.A., Ph.D., Research Chemist, Waite Agricultural Research Institute, and 8 Ralston Grove, Myrtle Bank; Joan Eileen Walkley, B.Sc. (Lon.), 8 Ralston Grove, Myrtle Bank. A ballot was taken and the President declared the above as duly elected. Mr. Hosking, being present, was welcomed by the President as a new Fellow.

NOMINATIONS AS FELLOWS.—Constance Margaret Eardley, B.Sc., Curator of University Herbarium, 68 Wattle Street, Fullarton Estate; Violet Taylor, Accountant, 40 Eton Street, Malvern.

The President announced that a special sub-committee had recommended that the next award of the Sir Joseph C. Verco Medal be made to Professor J. Burton Cleland. Professor T. Harvey Johnston, in moving that the recommendation be endorsed, gave a brief resumé of Professor Cleland's outstanding qualifications and research work. The motion was seconded by Mr. G. Samuel and carried with acclamation. Professor Cleland suitably responded.

The Annual Report of the Council was read by the Secretary. It was moved by Mr. J. M. Black, seconded by Dr. L. Keith Ward, and carried, that the Report be adopted.

The Financial Statement was presented by the Treasurer. It was moved by Dr. W. Christie, seconded by Mr. E. H. Ising, and carried, that the Financial Statement be adopted.

ELECTION OF OFFICERS FOR THE YEAR 1933-34.—The President read the following nominations which had been received:—PRESIDENT, Mr. J. M. Black, A.L.S.; SENIOR VICE-PRESIDENT, Dr. T. D. Campbell; JUNIOR VICE-PRESIDENT, Mr. C. T. Madigan, M.A., B.E.; TREASURER, Dr. W. Christie; SECRETARY, Mr. Ralph W. Segnit, M.A., B.Sc.; EDITOR, Professor Walter Howchin, F.G.S.; MEMBERS OF THE COUNCIL: Dr. L. Keith Ward, B.A., B.E., Dr. H. K. Fry, D.S.O., B.Sc.; AUDITORS: Mr. W. C. Hackett and Mr. O. A. Glastonbury. As no ballot was necessary, the retiring President declared the persons abovementioned as duly elected.

Professor Prescott thanked Dr. Chas. Fenner for the services he had rendered during the past year as Treasurer.

Professor Howchin informed the Fellows that he desired to be relieved of the duties as Editor, which he had first carried out 50 years ago. He felt that he must devote the whole time of the coming days to the preparation of geological papers which he desired to have published. He intimated that he was willing to carry on until the current volume of the Transactions was published. The retiring President thanked Professor Howchin for the valuable services he had rendered

to the Society for so many years, and assured him that the Council would give serious considerations to his request.

A welcome was extended to Dr. Wm. Christie and Dr. H. K. Fry as new Members of the Council.

PAPERS—

"Additions to the Flora of South Australia, No. 31," by J. M. Black, A.L.S.

"Australian Fungi: Notes and Descriptions, No. 9," by Professor J. Burton Cleland, M.D.

"On the Eremian Representative of *Myrmecobius fasciatus* (Waterhouse)," by H. H. Finlayson.

"On Mammals from the Lake Eyre Basin, Part I, Dasyuridae," by H. H. Finlayson.

"Notes on the Flora of South Australia, No. 2," by E. H. Ising.

"New Australian Lepidoptera," by A. Jefferis Turner, M.D., F.E.S.

The retiring President drew attention to the first Album of Officers of the Society, which has now been completed and contains practically the whole of the office-bearers since the foundation of the Society.

ANNUAL REPORT.

PRESENTED AT THE ANNUAL MEETING ON OCTOBER 12, 1933.

The average attendance of Fellows at the meetings held during the year has been 29.

At the meeting held in April, the President handed to Mr. J. M. Black the Müeller Medal, awarded to him by the Australian and New Zealand Association for the Advancement of Science at the meeting held in Sydney, 1932.

The President extended a welcome to Professor Sir Douglas Mawson on his return from abroad.

Professor Sir T. W. Edgeworth David, an Honorary Fellow of the Society, was present at the meeting held in April.

Dr. L. Keith Ward was elected to fill the vacancy on the Council caused by the death of Sir Joseph C. Verco.

The following Fellows took part in the Adelaide University and Museum Anthropological Expedition to Central Australia:—Professor J. Burton Cleland (Leader), Professor T. Harvey Johnston, Mr. H. M. Hale, Dr. H. K. Fry, and Mr. N. B. Tindale.

Mr. B. S. Roach resigned from the office of Treasurer which he occupied for 12 years, and Dr. Chas. Fenner was elected to fill the vacancy.

Mr. A. M. Ludbrook resigned from the position of Librarian after 20 years' service, and Mr. P. E. Madigan was appointed to that position.

During the year two of the Ordinary Meetings of the Society were devoted to special subjects, in the form of lectures, which were well attended. The first was delivered by Mr. H. M. Hale and Professor T. Harvey Johnston on "Australian Water Animals and their Shift for a Living." The second was by Dr. Ivan F. Phipps on "Heredity as we see it Today." Both lectures were illustrated by lantern slides, and the former by a number of characteristic specimens.

Geological papers were read by Professor Walter Howchin, Dr. L. Keith Ward, and two by Mr. N. B. Tindale.

Entomological papers were presented by Mr. J. W. Evans, Dr. A. Jefferis Turner, and three by Mr. H. Womersley.

Three Zoological papers were read by Mr. H. H. Finlayson.

Botanical papers were contributed by Mr. J. M. Black, Mr. A. B. Cashmore (communicated by Mr. J. M. Black), Mr. T. T. Colquhoun, Dr. R. S. Rogers, two by Professor J. Burton Cleland and two by Mr. E. H. Ising.

During the year the Society has suffered loss by death of three Fellows, Mr. W. W. Weidenbach, who was elected in 1920, and Mr. M. S. Hawker, who was elected in 1928.

Sir Joseph C. Verco, a Founder of the Society, and a Past President, died in August. An Obituary Notice (with portrait) of Sir Joseph C. Verco appears on page v.

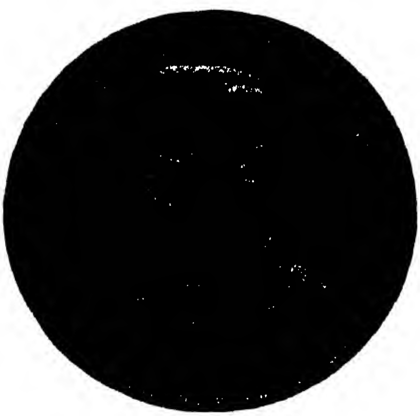
The Membership of the Society shows an increase. The number of Fellows elected during the year being 14. Five Fellows resigned, and 3 died. The Membership Roll at the close of the financial year is:—Honorary Fellows, 5; Fellows, 166; Associates, 1. Total, 172.

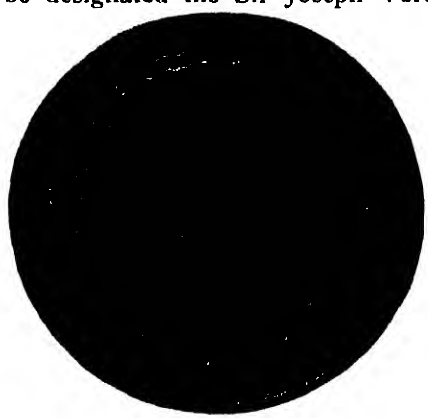
J. A. Prescott, President.

Ralph W. Segnit, Secretary.

THE SIR JOSEPH VERCO MEDAL.

The Council, on August 23, 1928, having resolved to recommend to the Fellows of the Society that a medal should be founded to give honorary distinction for scientific research, and that it should be designated the Sir Joseph Verco





Medal, was submitted to the Society at the evening meeting of October 11, 1928, and at a later meeting, held on November 8, 1928, when the recommendation of the Council was confirmed on the following terms:—

Regulations.

XI.—The medal shall be of bronze, and shall be known as the Sir Joseph Verco Medal, in recognition of the important service that gentleman has rendered to the Royal Society of South Australia. On the obverse side of the medal shall be these words: 'The Sir Joseph Verco Medal of the Royal Society of South Australia,' surrounding the modelled portrait of Sir Joseph Verco, while on the reverse side of the medal there shall be a surrounding wreath of eucalypt, with the words: 'Awarded to .... for Research in Science,' the name of the recipient, and the year of the award. The Council shall select the person to whom it is suggested that the medal shall be awarded, and that name shall be submitted to the Fellows at an Ordinary Meeting to confirm, or otherwise, the selection of the Council, by ballot or show of hands. The medal shall be awarded for distinguished scientific work published by a Member of the Royal Society of South Australia."

Awards.

1929 Prof. Walter Howchin, F.G.S.
1930 John McC. Black.
1931 Prof. Sir Douglas Mawson, B.E., D.Sc., F.R.S.
1933 Prof. J. Burton Cleland, M.D.

ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED).

Receipts and Payments for the Year ended September 30, 1933.

RECEIPTS.

	£ s. d.	£ s. d.
To Balance, October 1, 1932		705 0 4
„ Subscriptions		157 10 4
„ Use of Room by other Societies	3 2 6	
„ Sale of Publications	6 19 11	
„ Exchange	0 5 1	
„ Librarian, Petties	0 8 6	
		10 16 0
„ Donation towards Publishing Paper— C. T. Madigan		7 0 0
„ Interest—		
Savings Bank Account	17 10 4	
Transferred from Endowment Fund	145 2 1	
		162 12 5
		£1,042 19 1

PAYMENTS.

		£ s. d.	£ s. d.
By Transactions—			
Printing		157 16 10	
Illustrating		28 8 6	
Publishing		7 19 11	
			194 5 3
„ Library—			
Librarian		42 8 9	
Bookbinding		9 8 0	
			51 16 9
„ Sundries—			
Cleaning and Lighting		11 1 10	
Printing, Postages and Stationery		32 0 0	
Petties		2 16 8	
Insurance		6 15 0	
			52 13 6
„ Balance, September 30, 1933—			
Savings Bank of S.A.		724 7 1	
Bank of Australasia	£40 17 11		
Less Outstanding Cheques	21 1 5		
		19 16 6	
			744 3 7
			£1,042 19 1

Audited and found correct,

W. CHAMPION HACKETT }
O. GLASTONBURY, A.A.I.S., A.F.I.A. } Hon. Auditors.

CHARLES FENNER, Hon. Treasurer.

Adelaide, October 10, 1933.

ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED).

ENDOWMENT FUND.

As at September 30, 1933.

(Capital . . £4,286 13 7d.)

	£ s. d.	£ s. d.		£ s. d.	£ s. d.
1932—October 1.			1933—September 30.		
To Balance—			By Revenue Account .		145 2 1
Australian Consolidated Stock	4,280 0 0		„ Australian Consolidated Stock at Face Value	4,280 0 0	
Savings Bank of S.A.	6 13 7		„ Savings Bank Account	6 13 7	
		4,286 13 7			4,286 13 7
„ Interest Received		145 2 1			
		£4,431 15 8			£4,431 15 8

Audited and found correct,

W. CHAMPION HACKETT } Hon.
O. GLASTONBURY, A.A.I.S., A.F.I.A. } Auditors.

CHARLES FENNER, Hon. Treasurer.

Adelaide, October 10, 1933.

THE ENDOWMENT FUND.

1902.—On the motion of the late Samuel Dixon it was resolved that steps be taken for the incorporation of the Society and the establishment of an Endowment and Scientific Research Fund. Vol. xxvi., pp. 327-8.

1903.—The incorporation of the Society was duly effected and announced. Vol. xxvii., pp. 314-5.

1905.—The President (Dr. J. C. Verco) offered to give £1,000 to the Fund on certain conditions. Vol. xxix., p. 339.

1929.—The following are particulars of the contributions received and other sources of revenue in support of the Fund up to date:—

SUMMARY OF THE ENDOWMENT FUND.

(Capital £4,069 6s. 10d.)

Contributions.

	£	s.	d.	£	s.	d.	£	s.	d
Donations—									
1908, Dr. J. C. Verco	1,000	0	0						
1908, Thomas Scarfe	1,000	0	0						
1911, Dr. Verco	150	0	0						
1913, Dr. Verco	120	0	0						
Mrs. Ellen Peterswald	100	0	0						
Small Sums	6	0	0						
				2,376	0	0			
Bequests—									
1917, R. Barr Smith	1,005	16	8						
1920, Sir Edwin Smith	200	0	0						
				1,205	16	8			
Life Members' Subscriptions				225	0	0			
*Interest and Discounts				156	3	10			
From Current Account				106	6	4			
							4,069	6	10

*Interest on investments has, in the main, been transferred to general revenue for the publication of scientific papers. See Balance-sheets.

GRANTS MADE IN AID OF SCIENTIFIC RESEARCH.

	£	s.	d.
1916, G. H. Hardy, "Investigations into the Flight of Birds"	15	0	0
1916, Miss H. A. Rennie, "Biology of *Lobelia gibbosa*"	2	2	0
1921, F. R. Marston, "Possibility of obtaining from Azine precipitate samples of pure Proteolytic Enzymes"	30	0	0
1921, Prof. Wood Jones, "Investigations of the Fauna and Flora of Nuyts Archipelago"	44	16	7

ROYAL SOCIETY LIBRARY.

List of Governments, Societies and Editors with whom Exchanges of Publications are made.

AUSTRALIA.

Australasian Institute of Mining and Metallurgy, Melbourne.
Bureau of Census and Statistics, Canberra.
Council for Scientific and Industrial Research, Melbourne.
Library of Commonwealth Parliament.

SOUTH AUSTRALIA.

Botanic Garden, Adelaide.
Mines Department, Adelaide.
Public Library, Museum, and Art Gallery of South Australia.
Royal Geographical Society of Australasia (S.A. Branch).
South Australian Institutes Association, Adelaide.
South Australian Museum, Adelaide.
South Australian Naturalist, Adelaide.
South Australian Ornithologist, Adelaide.
South Australian Parliamentary Library.
University of Adelaide.
Waite Agricultural Research Institute, Glen Osmond.

NEW SOUTH WALES.

Australian Museum, Sydney.
Botanic Gardens, Sydney.
Department of Agriculture, Sydney.
Linnean Society of New South Wales.
Mines Department, Sydney.
Public Library of New South Wales.
Royal Society of New South Wales.
Royal Zoological Society of New South Wales.
School of Public Health and Tropical Medicine, Sydney.
Technological Museum, Sydney.
University of Sydney.

QUEENSLAND.

Department of Agriculture, Brisbane.
Geological Survey, Brisbane.
Queensland Museum, Brisbane.
Public Library of Queensland, Brisbane.
Royal Society of Queensland, Brisbane.
University of Queensland, Brisbane.

TASMANIA.

Government Geologist, Mines Department, Hobart.
Public Library of Tasmania, Hobart.
Royal Society of Tasmania, Hobart.
University of Tasmania, Hobart.

VICTORIA.

Field Naturalists' Club of Victoria, Melbourne.
Government Botanist, National Herbarium, Melbourne.
Mines Department, Melbourne.
National Museum, Melbourne.
Public Library of Victoria, Melbourne.
Royal Society of Victoria, Melbourne.
University of Melbourne.

WESTERN AUSTRALIA.

Geological Survey Department, Perth.
Public Library of Western Australia, Perth.
Royal Society of Western Australia, Perth.
University of Western Australia, Perth.

ENGLAND.

British Museum Library, London.
British Museum (Natural History), South Kensington.
Cambridge Philosophical Society.
Cambridge University Library.
Conchological Society of Great Britain and Ireland.
Entomological Society of London.
Geological Society of London.
Geologists' Association, London.
Hill Museum, Witley, Surrey.
Imperial Institute, South Kensington.
Imperial Institute of Entomology, London.
Linnean Society of London.
Liverpool Biological Society.
Manchester Literary and Philosophical Society.
National Physical Laboratory, Teddington.
Rhodes House Library, Oxford.
Rothamsted Experimental Station, Harpenden.
Royal Botanic Gardens, Kew.
Royal Empire Society, London.
Royal Geographical Society, London.
Royal Microscopical Society, London.
Royal Society, London.
Science Museum, South Kensington.
Zoological Museum, Tring, Herts.
Zoological Society of London.

SCOTLAND.

Edinburgh Geological Society.
Geological Society of Glasgow.
Royal Society of Edinburgh.

IRELAND.

Royal Dublin Society.
Royal Irish Academy, Dublin.

ARGENTINE REPUBLIC.

Academia Nacional de Ciencias, Cordoba.
Facultad de Ciencias Medicas, Buenos Aires.

AUSTRIA.

Akademie der Wissenschaften, Vienna.
Geologische Bundesanstalt, Vienna.
Naturhistorisches Museum, Vienna.
Zoologisch-Botanische Gesellschaft, Vienna.

BELGIUM.

Académie Royale de Belgique, Brussels.
Instituts Solvay, Brussels.
Musée Royale d'Histoire Naturelle de Belgique, Brussels.
Société Entomologique de Belgique, Ghent.
Société Royale de Botanique de Belgique, Brussels.
Société Royale des Sciences de Liège.
Société Royale Zoologique de Belgique, Brussels.

BRAZIL.

Instituto Oswaldo Cruz, Rio de Janeiro.
Museu Paulista, Sao Paulo.

CANADA.

Canadian Geological Survey, Ottawa.
Department of Agriculture, Ottawa.
National Research Council of Canada, Ottawa.
Nova Scotian Institute of Science, Halifax.
Royal Canadian Institute, Toronto.
Royal Society of Canada, Ottawa.
University of British Columbia, Vancouver.

CHINA.

Geological Survey of China, Peiping.
Institute of Biology, National Library of Peiping.

CZECHO-SLOVAKIA.

Ceskoslovenska Botanicka Spolecnost, Prague.

DENMARK.

Conseil Permanent International pour l'Exploration de la Mer.
Danske Naturhistorisk Forening. Copenhagen.
Kobenhavn Universitets Zoologiske Museum.
K. Danske Videnskabernes Selskabs. Copenhagen.

ESTHONIA.

Universitas Tartuensis, Tartu (Dorpat).

FINLAND.

Academia Scientiarum Fennica, Helsinki.
Societas Entomologica Helsingforsiensis.
Societas Scientiarum Fennica, Helsingfors.

FRANCE.

Muséum National d'Histoire Naturelle, Paris.
Société Bourguignonne d'Histoire Naturelle et de Préhistoire, Toulouse.
Société des Sciences Naturelles de l'Ouest de la France, Nantes.

Société Entomologique de France, Paris.
Société Géologique de France, Paris.
Société Linnéenne de Bordeaux.
Societe Linnéenne de Normandie, Caen.

GERMANY.

Bayerische Akademie der Wissenschaften zu München.
Berliner Gesellschaft für Anthropologie, Ethnologie, und Urgeschichte.
Bibliothek der Botanischen Gartens und Museums, Berlin.
Fedde, F.: Repertorium specierum novarum regni vegetabilis, Berlin.
Gesellschaft der Wissenschaften zu Göttingen.
Gesellschaft für Erdkunde zu Berlin.
K. Leopoldinische Deutsche Akademie de Naturforscher, Halle.
Naturforschende Gesellschaft, Freiburg.
Preussische Akademie der Wissenschaften, Berlin.
Senckenbergische Bibliothek, Frankfürt a. M.
Zoologische Museum der Universitat, Berlin.
Zoologische Staatsinstitut und Zoologische Museum, Hamburg.

HAWAIIAN ISLANDS.

Bernice Pauahi Bishop Museum, Honolulu.
Hawaiian Entomological Society, Honolulu.

HOLLAND.

Musée Teyler, Haarlem.
Rijks Herbarium, Leiden.

HUNGARY.

Hydrological Dept., Hungarian Geological Soc., Budapest.
Musée National Hongrois, Budapest.

INDIA.

Colombo Museum.
Government Museum, Madras.
Geological Survey of India, Calcutta.
Royal Asiatic Society, Bombay Branch and Malayan Br.
Zoological Survey of India, Calcutta.

ITALY.

Laboratorio di Entomologia, Bologna.
Laboratorio di Zoologia Agraria, Milan.
Laboratorio di Zoologia Generale e Agraria, Portici.
Società di Scienze Naturali ed Economiche, Palermo.
Società Entomologica Italiana, Genova.
Società Italiana di Scienze Naturali, Milano.
Società Toscana di Scienze Naturali, Pisa.

JAPAN.

Hiroshima University.
Kyōto Imperial University.
Ohara Institute for Agricultural Research, Kurashiki.
Taihoku Imperial University.
Tokyo Imperial University.

MEXICO.

Instituto de Biologia, Chapultepec.
Instituto Geológico de Mexico.
Sociedad Cientifica "Antonio Alzate," Mexico.

NEW ZEALAND.

Auckland Institute and Museum.
Dominion Museum, Wellington.
New Zealand Institute, Wellington.
Otago University Museum, Dunedin.
Philosophical Institute of Canterbury, Christchurch.

NORWAY.

Bergens Museum, Bergen.
Kongelige Norske Videnskabers Selskabs, Trondheim.
Tromso Museum.

PHILIPPINE ISLANDS.

Philippine Journal of Science, Manila.

POLAND.

Société Botanique de Pologne, Warszawa.
Société Polonaise des Naturalistes "Kopernik," Lwow.

RUSSIA.

Academie of Sciences, Leningrad.
Comité Géologique de Russie, Leningrade.
Institute of Plant Industry, Leningrad.
Siberian Mining Institute Library, Irkutsk.

SPAIN.

Instituto Nacional de Segunda Ensenanza de Valencia.
Real Academia de Ciencias y Artes, Barcelona.

SWEDEN.

Entomologiska Föreningen i Stockholm.
Geologiska Föreningen, Stockholm.
Stockholm's Högskolas Bibliotek, Stockholm.
Regia Societas Scientiarum Upsaliensis, Upsala.

SWITZERLAND.

Naturforschende Gesellschaft, Basel.
Société de Physique et d'Histoire Naturelle de Genève.
Société Neuchâteloise des Sciences Naturelles, Neuchâtel.
Société Vaudoise des Sciences Naturelles, Lausanne.
Zentralbibliothek, Zürich.

UNION OF SOUTH AFRICA.

Albany Museum, Grahamstown.
Geological Society of South Africa, Johannesburg.
Royal Society of South Africa, Cape Town.
South African Museum, Cape Town.
South African Association for the Advancement of Science, Johannesburg.

UNITED STATES.

Academy of Natural Sciences of Philadelphia.
Academy of Science of St. Louis.
American Academy of Arts and Sciences, Boston.
American Chemical Society, Columbus, O.
American Geographical Society, New York.
American Microscopical Society, Manhattan, Kans.
American Museum of Natural History, New York.
American Philosophical Society, Philadelphia.
Arnold Arboretum, Jamaica Plain, Mass.
Biological Survey of the Mount Desert Region, Bar Harbour, Me.
Boston Society of Natural History, Boston, Mass.
Brooklyn Institute of Arts and Sciences.
California Academy of Sciences, San Francisco.
Californian State Mining Bureau, San Francisco.
California, University of, Berkeley, Cal.
Chicago Academy of Sciences.
Citrus Experiment Station, Riverside, Cal.
Connecticut State Library, Hartford, Conn.
Cornell University, Ithaca, N.Y.
Denison Scientific Association, Granville, O.
Field Museum of Natural History, Chicago, Ill.
Franklin Institute of the State of Pennsylvania, Philad.
Harvard Museum of Comparative Zoology, Cambridge, Mass.
Illinois State Natural History Survey, Urbana, Ill.
Illinois University Library, Urbana, Ill.
Indiana Academy of Science, Indianapolis.
Johns Hopkins University, Baltimore, Md.
Kansas University, Lawrence, Kans.
Marine Biological Laboratory, Wood's Hole, Mass.
Maryland Geological Survey, Baltimore, Md.
Michigan University, Chicago.
Missouri Botanical Garden Library, St. Louis, Mo.
Missouri, University of, Columbia.
National Academy of Science, Washington, D.C.
National Geographic Society, Washington, D.C.
New York Academy of Sciences, New York.
New York Public Library.
New York State Library, Albany, N.Y.
Ohio State University Library, Columbus, O.
Princeton University, Princeton, N.J.
San Diego Society of Natural History, San Diego, Cal.
Smithsonian Institution and Bureau of Ethnology, Washington.
United States Department of Agriculture, Washington, D.C.
United States Geological Survey, Washington, D.C.
United States National Museum, Washington, D.C.
Wagner Free Institute of Science, Philadelphia, Pa.
Washington University, St. Louis, Mo.
Yale University Library, New Haven, Conn.

URUGUAY.

Museo de Historia Natural de Montevideo.

LIST OF FELLOWS, MEMBERS, ETC.

AS EXISTING ON SEPTEMBER 30, 1933.

Those marked with an asterisk (*) have contributed papers published in the Society's Transactions. Those marked with a dagger (†) are Life Members.

Any change in address or any other changes should be notified to the Secretary.

Note.—The publications of the Society will not be sent to those whose subscriptions are in arrear.

Date of Election.

Honorary Fellows.

1910. *Bragg, Sir W. H., O.M., K.B.E., M.A., D.C.L., LL.D., D.Sc., F.R.S., Director of the Royal Institution, Albemarle Street, London (Fellow 1886).
1926. *Chapman, F., A.L.S., National Museum. Melbourne.
1897. *David, Sir T. W. Edgeworth, K.B.E., C.M.G., D.S.O., B.A., D.Sc., F.R.S. F.G.S., Emeritus Professor of Geology, University of Sydney, Coringah, Sherbroke Road, Hornsby, N.S.W.
1898. *Meyrick, E. T., B.A., F.R.S., F.Z.S., Thornhanger, Marlborough, Wilts, England.
1894. *Wilson, J. T., M.D., Ch.M., F.R.S., Professor of Anatomy, Cambridge University, England.

Fellows.

1926. Abel, L. M., Chapman Camp, British Columbia.
1925. Adey, W. J., 32 High Street, Burnside, S.A.
1927. *Alderman, A. R., M.Sc., F.G.S., West Terrace, Kensington Gardens, S.A.
1931. Andrew, Rev. J. R., Woodside.
1929. Angel Frank M., Box 1327G, G.P.O., Adelaide.
1895. †*Ashby, Edwin, F.L.S., M.B.O.U., Blackwood, S.A.—**Council**, 1900-19; **Vice-President**, 1919-21.
1902. *Baker, W. H., King's Park, S.A.
1930. Barnes, T. A., B.Sc., 13 Leah Street, Forestville.
1926. Beck, B. B., 127 Fullarton Road, Myrtle Bank, S.A.
1932. Begg, P. R., B.D.Sc., L.D.S., 219 North Terrace, Adelaide.
1928. Best, R. J., M.Sc., A.A.C.I., Waite Agricultural Research Institute, Glen Osmond.
1928. *Best, Mrs. E. W., M.Sc., Claremont, Glen Osmond.
1931. Birch, H. McI., M.R.C.S., M.R.C.P., D.P.M., Mental Hospital, Parkside.
1930. Birks, W. R., B.Sc., 7 Kensington Road, Kensington.
1907. *Black, J. M., A.L.S., 82 Brougham Place, North Adelaide—**Sir Joseph Verco Medal**, 1930; **Council**, 1927-1931; **President**, 1933-; **Vice-President**, 1931-33.
1924. Browne, J. W., B.Ch., 169 North Terrace, Adelaide.
1916. *Bull, Lionel B., D.V.Sc., Laboratory, Adelaide Hospital
1923. Burdon, Roy S., B.Sc., University of Adelaide.
1921. Burton, R. J., c/o P.O., Kalgoorlie, W.A.
1922. *Campbell, T. D., D.D.Sc., Dental Dept., Adelaide Hospital, Frome Road, Adelaide—**Rep.-Governor**, 1932-; **Council**, 1928-32; **Vice-President**, 1932-.
1907. *Chapman, R. W., C.M.G., M.A., B.C.E., F.R.A.S., Professor of Engineering and Mechanics, University, Adelaide—**Council**, 1914-22.
1931. *Chewings, Chas., Ph.D., F.G.S., "Alverstroke," Glen Osmond.
1929. Christie, W., M.B., B.S., Education Department, Flinders Street, Adelaide—**Treasurer**, 1933-.
1930. Clarke, G. H., B.Sc., Agricultural College, Roseworthy.
1895. *Cleland, John B., M.D., Professor of Pathology, University, Adelaide—**Council**, 1921-26, 1932-; **President**, 1927-28; **Vice-President**, 1926-27.
1930. Collins, F. V., B.V.Sc., Green Road, Woodville.
1930. *Colquhoun, T. T., M.Sc., University, Adelaide.
1907. *Cooke, W. T., D.Sc., A.A.C.I., Lecturer, University of Adelaide.
1929. *Cotton, Bernard C., S.A. Museum, Adelaide.
1924. de Crespigny, C. T. C., D.S.O., M.D., 219 North Terrace, Adelaide.
1929. Davidson, James, D.Sc., Waite Agricultural Research Institute, Glen Osmond—**Council**, 1932-.
1928. Davies, J. G., B.Sc., Ph. D., Waite Agricultural Research Institute, Glen Osmond.
1927. *Davies, Prof. E. Harold, Mus.Doc., The University, Adelaide.
1927. Dawson, Bernard, M.D., F.R.C.S., Otago University, Dunedin, New Zealand.
1930. Dix, E. V., Glynde Road, Firle.
1915. *Dodd, Alan P., Prickly Pear Laboratory, Sherwood, Brisbane.
1932. Dunstone, H. E., M.B., B.S., J.P., 124 Payneham Road, St. Peters.
1921. Dutton, G. H., B.Sc., Agricultural High School. Murray Bridge.

Date of Election.

1931. Dwyer, J. M., M.B., B.S., Adelaide Hospital.
1902. *Edquist, A. G., 19 Farrell Street, Glenelg.
1918. *Elston, A. H., F.E.S.. "Llandyssil," Aldgate.
1925. England, H. N., B.Sc., Commonwealth Research Station, Griffith, N.S.W.
1932. *Evans, J. W., M.A., Waite Agricultural Research Institute, Glen Osmond.
1917. *Fenner, Chas. A. E., D.Sc., 42 Alexander Avenue, Rose Park—**Rep.-Governor,** 1929-31; **Council,** 1925-28; **President,** 1930-31; **Vice-President,** 1928-30; **Secretary,** 1924-25; **Treasurer,** 1932-33; **Editor,** 1934.
1927. *Finlayson, H. H., The University of Adelaide.
1929. Freney, M. Raphael.
1929. Freney, M. Richard.
1931. Frewin, O. W., M.B., B.S., Woodville.
1923. *Fry, H. K., D.S.O., M.B., B.S., B.Sc., Glen Osmond Road, Parkside—**Council,** 1933-.
1930. Garrett, S. D., B.A., Waite Agricultural Research Institute, Glen Osmond.
1932. *Gibson, E. S. H., B.Sc., 297 Cross Roads, Clarence Gardens.
1919. †Glastonbury, O. A., Adelaide Cement Co., Brookman Buildings, Grenfell Street.
1923. Glover, C. R. J., Stanley Street, North Adelaide.
1927. Godfrey, F. K., Robert Street, Payneham, S.A.
1904. Gordon, David, 72 Third Avenue, St. Peters.
1925. †Gosse, J. H., Gilbert House, Gilbert Place, Adelaide.
1880. *Goyder, George, A.M., B.Sc., F.G.S., 232 East Terrace, Adelaide.
1910. *Grant, Kerr, M.Sc., Professor of Physics, University, Adelaide—**Council,** 1912-15.
1930. Gray, James H., M.B., B.S., Adelaide Hospital.
1931. Gray, James T., Orroroo, S.A.
1930. Greaves, H., Director, Botanic Garden, Adelaide.
1904. Griffith, H., Hove, Brighton.
1916. Hackett, W. Champion, 35 Dequetteville Terrace, Kent Town.
1927. *Hackett, Dr. C. J., 196 Prospect Road, Prospect, S.A.
1922. *Hale, H. M., The Director, S.A. Museum, Adelaide—**Council,** 1931-.
1930. Hall, F. J., Adelaide Electric Supply Coy., Ltd., Adelaide.
1922. *Ham, William, F.R.E.S., 112 Edward Street, Norwood.
1916. †Hancock, H. Lipson, A.M.I.C.E., M.I.M.M., A.Am.I.M.E., Bewdley, 66 Beresford Road, Bellevue Hill, Rose Bay, Sydney.
1924. Hawker, Captain C. A. S., M.A., M.H.R., Dillowie, Hallett, South Australia.
1923. Hill, Florence McCoy M., B.S., M.D., Elizabeth Street, Sydney, N.S.W.
1927. Holden, E. W., B.Sc., Dequetteville Terrace, Kent Town, S.A.
1930. Hosking, H. C., B.A., 24 Northcote Terrace, Gilberton.
1929. Hosking, John W., 77 Sydenham Road, Norwood.
1930. Hosking, J. S., B.Sc., Waite Agricultural Research Institute, Glen Osmond.
1924. *Hossfeld, Paul S., M.Sc., Office of Home and Territories, Canberra.
1883. *Howchin, Professor Walter, F.G.S., "Stonycroft," Goodwood East—**Sir Joseph Verco Medal,** 1929; **Rep.-Governor,** 1901-22; **Council,** 1883-84, 1887-89, 1890-94, 1902-; **President,** 1894-96; **Vice-President,** 1884-87, 1889-90, 1896-1902; **Editor,** 1883-88, 1893-94, 1895-96, 1901-1933.
1928. Hurcombe, Miss J. C., 95 Unley Road, New Parkside.
1928. Ifould, Percy, Kurralta, Burnside.
1918. *Ising, Ernest H., c/o Comptroller's Office, S.A. Railways, Adelaide
1918. *Jennison, Rev. J. C., 7 Frew Street, Fullarton Estate.
1910. *Johnson, E. A., M.D., M.R.C.S., Town Hall, Adelaide.
1921. *Johnston, Professor T. Harvey, M.A., D.Sc., University, Adelaide—**Rep.-Governor,** 1927-29; **Council,** 1926-28; **Vice-President,** 1928-31; **President,** 1931-32.
1929. Johnston, W. C., Government Agricultural Inspector, Riverton.
1920. *Jones, Professor F. Wood, M.B., B.S., M.R.C.S., L.R.C.P., D.Sc., F.R.S., University, Melbourne—**Rep.-Governor,** 1922-27; **Council,** 1921-25; **President,** 1926-27; **Vice-President,** 1925-26.
1926. Julius, Edward, Conservator of Forests, Adelaide.
1918. Kimber, W. J., 28 Second Avenue, Joslin.
1930. Kleeman, A. W., 12 Ningara Avenue, Kings Park.
1915. *Laurie, D. F., Agricultural Department, Flinders Street, Adelaide.
1930. Le Messurier, D. H., B.Sc., 133 Mills Terrace, North Adelaide.
1884. Lendon, A. A., M.D., M.R.C.S., 66 Brougham Place, North Adelaide.
1922. Lendon, Guy A., M.B., B.S., M.R.C.P., North Terrace.
1925. Lewis, A. S., M.D., B.S., The Maudsley Hospital, Denmark Hill, London, S.E. 5.
1930. Louwyck, Rev, N. H., The Rectory, Yankalilla.
1922. *Madigan, C. T., M.A., B.E., F.G.S., University of Adelaide—**Council,** 1930-33; **Vice-President,** 1933-.

Date of Election.

1923. Marshall, J. C.. Darrock, Payneham.
1928. *Maegraith, B. G., M.B., B.S., Magdalen College, Oxford, England.
1930. Magarey, Miss K. de B., B.A., B.Sc., 38 Winchester Street, Malvern.
1932. Mann, E. A., C/o Bank of Adelaide, Adelaide.
1929. Martin, F. C., B.A., Technical High School, Thebarton.
1905. *Mawson, Sir Douglas, D.Sc., B.E., F.R.S., Professor of Geology, University, Adelaide **Sir Joseph Verco Medal**, 1931; **President**, 1924-25; **Vice-President**, 1923-24, 1925-26.
1919. Mayo, Helen M., M.D., 47 Melbourne Street, North Adelaide.
1920. Mayo, Herbert, LL.B., K.C., 16 Pirie Street, Adelaide.
1929. McLaughlin, E., M.B., B.S., M.R.C.P., Adelaide Hospital (removed in error from last list).
1907. Melrose, Robert T., Mount Pleasant.
1930. Miller, J. I., 18 Ralston Street, Largs Bay.
1925. †Mitchell, Professor Sir William, K.C.M.G., M.A., D.Sc., The University, Adelaide.
1930. Mitchell, Miss U. H., B.Sc., Presbyterian Girls' College, Glen Osmond.
1930. Mitchell, M. L., B.Sc., Fitzroy Terrace, Prospect.
1897. *Morgan, A. M., M.B., Ch.B., 215 Brougham Place, North Adelaide.
1924. Morison, A. J., Deputy Town Clerk, Town Hall, Adelaide.
1930. Morris, L. G., Beehive Buildings, King William Street, Adelaide.
1921. Moulden, Owen M., M.B., B.S., Unley Road, Unley.
1925. †Murray, Hon. Sir George, K.C.M.G., B.A., LL.M., Magill, S.A.
1925. North, Rev. Wm. O., Methodist Manse, Netherby.
1930. Ockenden. G. P., Public School, Streaky Bay, S.A.
1932. Oliphant, H. R., University, Adelaide.
1913. *Osborn, T. G. B., D.Sc., Professor of Botany, University, Sydney—**Council**, 1915-20, 1922-24; **President**, 1925-26; **Vice-President**, 1924-25, 1926-27.
1927. Paltridge, T. B., B.Sc., Koonamore, via Waukaringa, S.A
1929. Pank, Harold G., 75 Rundle Street, Adelaide.
1929. Paull, Alec. G., B.A., B.Sc., 10 Milton Avenue, Fullarton Estate.
1924. Pearce, C., Happy Valley Reservoir, O'Halloran Hill.
1924. Perkins, A. J., Director of Agriculture, Flinders Street, Adelaide.
1928. Phipps, Ivan F., Ph.D., Waite Agricultural Research Institute, Glen Osmond.
1926. *Piper, C. S., M.Sc., Waite Agricultural Research Institute, Glen Osmond.
1925. *Prescott, Professor J. A., D.Sc., A.I.C., Waite Agricultural Research Institute, Glen Osmond—**Council**, 1927-30; **Vice-President**, 1930-32; **President**, 1932-.
1926. Price, A. Grenfell, M.A., D.Sc., F.R.G.S., St. Mark's College, North Adelaide.
1907. †*Pulleine Robert H., M.B., Ch.M., North Terrace, Adelaide—**Council**, 1914-19, 1932-; **President**, 1922-24; **Vice-President**, 1912-14, 1919-22, 1924-25; **Secretary**, 1909-12, 1925-30.
1925. Richardson, Professor A. E. V., M.A., D.Sc., "Urrbrae," Glen Osmond, S.A.
1926. *Riddell, P. D., Technical College, Newcastle, N.S.W.
1911. *Roach, B. S., 81 Kent Terrace, Kent Town—**Treasurer**, 1920-32.
1925. Rogers, L. S., B.D.Sc., 192 North Terrace, Adelaide.
1905. *Rogers, R. S., M.A., M.D., 52 Hutt Street, Adelaide—**Council**, 1907-14, 1919-21; **President**, 1921-22; **Vice-President**, 1914-19, 1922-24.
1931. Rudd, E. A., 10 Church Street, Highgate.
1922. *Samuel, Geoffrey, M.Sc., University of Adelaide
1928 Scott, A. E., B.Sc., Waite Agricultural Research Institute, Glen Osmond.
1930. Schneider, M., M.B., B.S., 175 North Terrace, Adelaide.
1924. *Segnit, Ralph W., M.A., B.Sc., Assistant Government Geologist, Flinders Street, Adelaide—**Secretary**, 1930-.
1891. Selway, W. H., 14 Frederick Street, Gilberton—**Council**, 1893-1909.
1930. Service, A. D., c/o Colonial Sugar Refinery Co., New Farm, Brisbane.
1926. *Sheard, Harold, Nuriootpa.
1928. Showell, H., 27 Dutton Terrace, Medindie.
1920. Simpson, A. A., C.M.G., C.B.E., F.R.G.S., Lockwood Road, Burnside.
1924. Simpson, Fred. N., Pirie Street, Adelaide.
1925. †Smith, T. E. Barr, B.A., 25 Currie Street, Adelaide.
1927. Stapleton, P. S., Henley Beach, South Australia.
1922. Sutton, J., Fullarton Road, Netherby.
1932. Swan, D. C., B.Sc., Waite Agricultural Research Institute, Glen Osmond.
1925. Symons, Ivor G., Church Street, Highgate.
1929. *Taylor, John K., B.A., M.Sc., Waite Agricutural Research Institute, Glen Osmond.
1929. Tee, Sidney F., Adelaide Hospital.
1923. *Thomas, R. G., B.Sc., 29 Carter Street, Thorngate, S.A.
1923. *Tindale, N. B., South Australian Museum, Adelaide.
1894. *Turner, A. Jefferis, M.D., F.E.S., Wickham Terrace, Brisbane, Queensland.

Date of Election.

1925. **Turner, Dudley C.**, National Chambers, King William Street, Adelaide.
1930. Walkley, A., B.A., B.Sc., Ph.D., 8 Ralston Grove, Myrtle Bank.
1930. Walkley, Mrs. J. E., B.Sc., (Lon.), 8 Ralston Grove, Myrtle Bank.
1924. Walker, W. D., M.B., B.S., B.Sc., c/o National Bank, King William Street.
1929. Walters, Lance S., 157 Buxton Street, North Adelaide.
1912. *Ward, L. Keith, B.A., B.E., D.Sc., Govt. Geologist, Flinders Street, Adelaide—**Council**, 1924-27, 1933-; **President**, 1928-30; **Vice-President**, 1927-28.
1930. Whitelaw, A. J., B.Sc., Norwood High School, Kensington.
1930. Wilkinson, Professor H. J., B.A., Ch.M., M.D., University, Adelaide.
1931. Wilson, Chas. E. C., M.B., B.S., "Woodfield," Fisher Street, Fullarton.
1920. *Wilton, Professor J. R., D.Sc., University of Adelaide.
1930. *Womersley, H., F.E.S., A.L.S., S.A. Museum, Adelaide.
1923. *Wood, J. G., D.Sc., Ph.D., University of Adelaide.
1931. *Woods, Miss N. H., M.A., Mount Torrens.

Associate.

1929. Cleland, W. Paton, 31 Wattle Street, Fullarton.

PAST AND PRESENT OFFICERS OF THE SOCIETY.

PRESIDENTS.

1877-79	Prof. Ralph Tate, F.G.S., F.L.S.
1879-81	Chief Justice [Sir] S. J. Way.
1881-82	[Sir] Charles Todd, C.M.G., F.R.A.S.
1882-83	H. T. Whittell, M.A., M.D., F.R.M.S.
1883-84	Prof. H. Lamb, M.A., F.R.S.
1884-85	H. E. Mais, M.I.C.E.
1885-88	Prof. E. H. Rennie, M.A., D.Sc., F.C.S.
1888-89	[Sir] Edward C. Stirling, C.M.G., M.A., M.D. (Cantab.), F.R.C.S., F.R.S.
1889-91	Rev. Thomas Blackburn, B.A.
1891-94	Prof. Ralph Tate, F.G.S., F.L.S.
1894-96	Prof. Walter Howchin, F.G.S.
1896-99	W. L. Cleland, M.B.
1899-03	Prof. E. H. Rennie, M.A., D.Sc., F.C.S.
1903-21	Sir Joseph C. Verco, M.D., F.R.C.S.
1921-22	R. S. Rogers, M.A., M.D.
1922-24	R. H. Pulleine, M.B., Ch.M.
1924-25	Sir Douglas Mawson, D.Sc., B.E., F.R.S.
1925-26	Prof. T. G. B. Osborn, D.Sc.
1926-27	Prof. F. Wood Jones, M.B., B.S., M.R.C.S., L.R.C.P., D.Sc., F.R.S.
1927-28	Prof. John B. Cleland, M.D.
1928-30	L. Keith Ward, B.A., B.E., D.Sc., F.G.S.A.
1930-31	C. A. E. Fenner, D.Sc.
1931-32	Prof. T. Harvey Johnston, M.A., D.Sc.
1932-33	Prof. J. A. Prescott, D.Sc., A.I.C.
1933-	J. M. Black, A.L.S.

SECRETARIES.

1877	W. C. M. Finniss.
1877-81	Walter Rutt, C.E.
1881-92	W. L. Cleland, M.B.
1892-93	W. C. Grasby.
1893-94	W. B. Poole.
1894-95	W. L. Cleland, M.B.; W. B. Poole.
1895-96	W. L. Cleland, M.B.
1896-09	G. G. Mayo, C.E.
1909-12	R. H. Pulleine, M.B., Ch.M.
1912-24	Walter Rutt, C.E.
1924-25	Chas. Fenner, D.Sc.
1925-30	R. H. Pulleine, M.B., Ch.M.
1930-	Ralph W. Segnit, M.A., B.Sc.

TREASURERS.

1877	J. S. Lloyd.
1877-83	Thomas H. Smeaton.
1883-92	Walter Rutt, C.E.
1892-94	W. L. Cleland, M.B.
1894-09	Walter Rutt, C.E.
1909-20	W. B. Poole.
1920-32	B. S. Roach
1932-33	Chas. Fenner, D.Sc.
1933-	W. Christie, M.B., B.S.

EDITORS.

1877-83	Prof. Ralph Tate, F.G.S., F.L.S.
1883-88	Prof. Walter Howchin, F.G.S.
1888-93	Prof. Ralph Tate, F.G.S., F.L.S.
1893-94	Prof. Walter Howchin, F.G.S.; Prof. Ralph Tate, F.G.S., F.L.S.
1894-95	Prof. Ralph Tate, F.G.S., F.L.S.
1895-96	Prof. Walter Howchin, F.G.S.
1896-00	Prof. Ralph Tate, F.G.S., F.L.S.
1901-33	Prof. Walter Howchin, F.G.S.
1934-	Chas. Fenner, D.Sc.

REPRESENTATIVE GOVERNORS.

1877-83	[Sir] Charles Todd, C.M.G., F.R.A.S.
1883-87	H. T. Whittell, M.A., M.D., F.R.M.S.
1887-01	Prof. Ralph Tate, F.G.S., F.L.S.
1901-22	Prof. Walter Howchin, F.G.S.
1922-27	Prof. F. Wood Jones, M.B., etc.
1927-29	Prof. T. H. Johnston, M.A., D.Sc.
1929-31	Chas. Fenner, D.Sc.
1932	T. D. Campbell, D.D.Sc.

APPENDIX.

A LIST OF ORIGINAL PAPERS AND OTHER WORKS PUBLISHED BY WALTER HOWCHIN FROM 1874 TO 1933.

[The Heading over each Section shows the Place of Publication.]

I.

PRIMITIVE METHODIST QUARTERLY REVIEW AND CHRISTIAN AMBASSADOR. PRIMITIVE METHODIST PUBLISHING HOUSE, SUTTON STREET, LONDON.

1874. "Scientific Dredging in the Deep Seas. Part I.," vol. xii., No. 47, Aug., 1874, pp. 221-233. [The *Lightning* and The *Porcupine* Expeditions.]

1874. "Scientific Dredging in the Deep Seas. Part II.," vol. xii., No. 48, Nov., 1874, pp. 353-361. [The *Challenger* Expedition.]

1875. "Scientific Dredging in the Deep Seas. Part III.," vol. xviii., No. 49, Feb., 1875, pp. 36-52. [The *Challenger* Expedition, continued.]

1876. "Geikie's Life of Murchison," vol. xiv., No. 53, Feb., 1876, pp. 29-45.

1876. "Sir Roderick I. Murchison and His Contemporaries," vol. xiv., No. 54, May, 1876, pp. 97-112.

1876. "The Present Aspects of Geological Science," vol. xiv., No. 56, Nov., 1876, pp. 320-330.

1889. "Darwinism and Design in Nature, Part I.," vol. xxxi. (N.S., vol. xi.), April, 1889, pp. 225-231.

1889. "Darwinism and Design in Nature, Part II.," vol. xxxi. (N.S., vol. xi), July, 1889, pp. 498-511.

II.

IN WILSON'S HANDBOOK TO MORPETH.

1876. "The Geology of Morpeth and Neighbourhood." Morpeth, 1876.

III.

PALAEONTOGRAPHICAL SOCIETY'S PUBLICATIONS.

1876. "Monograph of Carboniferous and Permian Foraminifera," by H. B. Brady, London, 1876.

References to Howchin's personal contributions will be found on the following pages:—

Localities reported on, pp. 29, 30 bis, 31 bis, 39, 41 tres.

References to particular genera and species, pp. 107, 119, 120, 121.

List of occurrences at particular localities:—

Table I. Nos. 2, 15, 16, 17, 18, p. 153.
Table II. Nos. 87, 103, 107, 116, pp. 154. 156.

Numerous figured specimens and micro-sections.

IV.

Natural History Transactions of Northumberland, Durham, and Newcastle-on-Tyne.

1880. "Notes on a Find of Prehistoric Implements in Allendale, with Notes of Similar Finds in the Surrounding Districts," vol. vii., 1880, pp. 210-222, Newcastle-on-Tyne.

V.

Journal of the Royal Microscopical Society, London.

1888. Additions to the Knowledge of the Carboniferous Foraminifera," 1888, pp. 1-13, pls. viii.-ix. [British Localities.]

VI.

The Hassell Press, Adelaide.

1899. "The Influence of the Physical Sciences on Religious Thought." "A Paper read before the Methodist Preachers' Association, Adelaide, on March 24, 1899, and published by request of the meeting."

VII.

Australasian Association for the Advancement of Science.

1893. "On the Occurrence of Foraminifera in the Permo-Carboniferous Rocks of Tasmania," vol. v., 1893, pp. 344-348, pls. 10-11. Adelaide.

1893. "A Census of the Fossil Foraminifera of Australia." vol. v., 1893, pp. 348-373. Adelaide.

1895. "Report of Glacial Research Committee, Hallett's Cove, South Australia," Tate, Howchin, and David, vol. vi., 1895, pp. 315-320, pls. 49-50. Brisbane.

1898. "On the Evidences of Glaciation in the Inman Valley, Yankalilla, and Cape Jervis Districts," vol. vii., 1898, pp. 114-127, pls. 2-3. Sydney.

1900. "Evidences of Glaciation in Hindmarsh Valley and Kangaroo Island." vol. viii., 1900 (1901), pp. 172-176, pls. 1, 2. Melbourne.

1902. Glacial Research Committee (S. Aust.): "(1) Permo-Carboniferous Glaciation of Southern Yorke Peninsula"; (2) "Glacial Beds of Assumed Cambrian Age," vol. ix., 1902, pp. 194-200, plate. Hobart.

1907. Glacial Research Committee: "Cambrian and (?) Permo-Carboniferous Glaciation in South Australia," vol. xi., 1907, pp. 264-272. [Inman Valley.] Adelaide.

1907. "General Description of the Cambrian Series of South Australia," vol. xi., 1907, pp. 414-422. Adelaide.

1911. Glacial Research Committee: "Cambrian and Permo-Carboniferous Glaciations in South Australia," vol. xiii., 1911, pp. 203-208. Sydney.

1913. "The Evolution of the Physiographical Features of South Australia." President's Address, Section C., vol. xiv., 1913, pp. 148-178, pls. 3-4. Melbourne.

1923. Glacial Research Committee: "Glacial Deposits at Yellow Cliff, etc., River Finke, Central Australia," by Sir Edgeworth David and Prof. Howchin, vol. xvi., 1923, pp. 74-94, pls. 1-3. Wellington, N.Z.

1923. "The Recent Extinction of Certain Marine Animals of the Southern Coast of Australia, together with other Facts that are suggestive of a change in Climate," vol. xvi., 1923, pp. 94-101. Wellington, N.Z.

1924. "The Sturtian Tillite in the Willouran Ranges, near Marree (Hergott) and in the north-eastern portions of the Flinders Ranges," vol. xvii., 1924 (1926), pp. 67-76. Adelaide.

VIII.

TRANSACTIONS AND PROCEEDINGS OF THE ROYAL SOCIETY OF SOUTH AUSTRALIA.

1884. "On the Fossil Foraminifera from the Government Boring at Hergott Township, with General Remarks on the Section and on other Forms of Microzoa observed therein," vol. viii., 1884-5, pp. 79-93.

1886. "Remarks on a Geological Section at the New Graving Dock, Glanville, with special reference to a Supposed Old Land Surface now below Sea Level.," vol. x., 1886-7, pp. 31-35.

1887. "Remarks on an Unusual Development of a Low Vegetable Organism," vol. ix., 1885-6 (1887), pp. 219-220.

1888. "The Foraminifera of the Older Tertiary of Australia (No. 1, Muddy Creek, Victoria)," vol. xii., 1888-9 (1889), pp. 1-20, pl. 1.

1890. "The Estuarine Foraminifera of the Port Adelaide River," vol., xiii., 1890, pp. 161-169.

1891. "The Foraminifera of the Older Tertiary. No. 2 (Kent Town Bore), Adelaide," vol. xiv., 1891, pp. 350-354, pl. 13, figs. 9-13.

1891. "The Foraminifera of the Older Tertiary, Muddy Creek, Victoria—Addenda et Corrigenda," vol. xiv., 1891, pp. 355-356, pl. 13, figs. 9, 10.

1892. "Note on the Occurrence of *Hyalostelia* in Rocks of Cambrian Age in South Australia," vol. xv., 1892, pp. 188-189. [For authorship, see p. 183.]

1893. "Notes on the Government Borings at Tarkaninna and Mirrabuckinna, with Special Reference to the Foraminifera observed therein," vol. xvii., 1893, pp. 346-349.

1895. "New Facts bearing on the Glacial Features of Hallett's Cove," vol. xix., 1895, pp. 61-69.

1895. "The Foraminifera of the Eocene [Miocene] Beds at Cape Otway." Included in "Correlation of the Marine Tertiaries of Australia, Part II., Victoria," by R. Tate and J. Dennant, vol. xix., 1895, p. 114.

1895. "Carboniferous Foraminifera of Western Australia with Descriptions of New Species," vol. xix., 1895, pp. 194-198, pl. 10, figs. 1-8.

1895. "Two New Species of Cretaceous Foraminifera," vol. xix., 1895, pl. 10, figs. 9-13.

1896. "Notes on a Bore at Enfield, near Adelaide," vol. xx., 1895-6, pp. 260-262. [Fresh-water Beds.]

1897. "On the Occurrence of Lower Cambrian Fossils in the Mount Lofty Ranges," vol. xxi., 1897, pp. 74-86.

1897. President's Address. Subject: "Recent Researches bearing on the Foraminifera," vol. xxi., 1897, pp. 106-121.

1898. "Further Discoveries of Glacial Remains in South Australia," vol. xxii., 1898, pp. 12-17. [Hindmarsh Valley.]

1899. "List of Foraminifera from the Murray Desert Beds," vol. xxiii., 1899, pp. 110-111.

1899. "Notes on the Geology of Kangaroo Island, with Special Reference to Evidences of Extinct Glacial Action," vol. xxiii., 1899, pp. 198-207, pls. 4, 5.

1900. "Evidences of Extinct Glacial Action in Southern Yorke Peninsula," vol. xxiv., 1900, pp. 71-80.

1900. "Suggestions as to the Origin of the Salt Lagoons of Southern Yorke Peninsula," vol. xxv., 1900-1 (1901), pp. 1-9.

1901. "Preliminary Note on the Existence of Glacial Beds of Cambrian Age in South Australia," vol. xxv., 1901, pp. 10-13.

1901. "Notes on the Extinct Volcanoes of Mount Gambier and Mount Schank," vol. xxv., 1901, pp. 54-62.

1903. "Further Notes on the Geology of Kangaroo Island," "Aboriginal Occupation of Kangaroo Island," vol. xxvii., 1903, pp. 75-90.

1904. "The Geology of the Mount Lofty Ranges, Part I., The Coastal District," vol. xxviii., 1904, pp. 253-280, pls. 37-44.

1906. "The Geology of the Mount Lofty Ranges, Part II.," vol. xxx., 1906, pp. 227-262, pl. 12.

1909. "Notes on the Discovery of a Large Mass of Living Coral in Gulf St. Vincent, with Bibliographical References to the Recent Corals of South Australia," vol. xxxiii., 1909, pp. 242-252, pl. 16.

1909. "Description of an Old Lake Area in Pekina Creek and its Relation to Recent Geological Changes," vol. xxxiii., 1909, pp. 253-261, pls. 17-18.

1910. "The Glacial (Permo-Carboniferous) Moraines of Rosetta Head and King's Point, South Australia," vol. xxxiv., 1910, pp. 1-12, pls. 1-17.

1910. "Description of a New and Extensive Area of Permo-Carboniferous Glacial Deposits in South Australia," vol. xxxiv., 1910, pp. 231-247, pls. 31-45. [Mount Compass and River Finniss Districts.]

1911. "Description of a Disturbed Area of Cainozoic Rocks in South Australia, with Remarks on its Geological Significance," vol. xxxv., 1911, pp. 47-59, pls. 10-19. [Sea-cliffs near Sellick's Hill.]

1912. "On an Outlier of Older Cainozoic Rocks in the River Light, near Mallala," vol. xxxvi., 1912, pp. 14-20, pl. 1.

1912. "Notes on Recurrent Transgressions of the Sea at Dry Creek," vol. xxxvi., 1912., pp. 34-39.

1914. "The Occurrence of the Genus *Cryptozoön* in the (?) Cambrian of Australia," vol. xxxviii., 1914, pp. 1-10, pls. 1-5.

1915. "A Geological Sketch-Map, with Descriptive Notes on the Upper and Lower Torrens Limestones in the Type District," vol. xxxix., 1915, pp. 1-15, pl. 1.

1915. "A List of Foraminifera and other Organic Remains obtained from Two Borings on the Lilydale Sheep Station,' vol. xxxix., 1915, pp. 345-351.

1916. A Note on *Hyalostelia* (included in a paper by R. Etheridge, jun., on *"Hyalostelia australis* . . . from the Ordovician Rocks of the MacDonnell Ranges," vol. xl., 1916, p. 150.

1916. "Notes on a High-level Occurrence of a Fossiliferous Bed of Upper Cainozoic Age in the Neighbourhood of the Murray Plains," vol. xl., 1916, pp. 258-261.

1916. "The Geology of Mount Remarkable; with an Appendix containing Petrographical Notes on the Igneous Rocks of the Foothills of Mount Remarkable by E. O. Thiele," vol. xl., 1916, pp. 545-583, pls. 53 and 54.

1917. "Notes on the Remarkable Hailstorm, near Adelaide, on May 12, 1917," vol. xli., 1917, pp. 323-332, pl. 16.

1917. "Notes on Diatomaceous Earth from Lord Howe Island," vol. xli., 1917, pp. 659-660.

1918. "Notes on the Geology of Ardrossan and Neighbourhood," vol. xlii., 1918, pp. 185-225, pls. 19-29.

1918. "A New Locality for Older Tertiary (Miocene) Fossiliferous Beds" [Hackham], vol. xlii., 1918, pp. 294-295.

1919. "Geological Memoranda" (First Contribution), vol. xliii., 1919, pp. 45-58, pl. 9:—

- I. "The 'Sarsen' Stones of South Australia."
- II. "Pumice and other Substances occurring as Sea-drift near Cape Banks."
- III. "Salt a Cause of Mechanical Disintegration of Rocks in Arid Regions."
- IV. "Nodular Barytes of Peculiar Forms from Central Australia," pl. 9.

1919. "Supplementary Notes on the Occurrence of Aboriginal Remains Discovered by Capt. S. A. White at Fulham, with Remarks on the Geological Section," vol. xliii., 1919, pp. 81-84.

1920. "Autoclastic, Intraformational, Enterolithic, and Desiccation Breccias and Conglomerates, with References to some South Australian Occurrences," vol. xliv., 1920, pp. 300-321, pls. 16-21.

1920. "Miscellanea," vol. xliv., 1920, pp. 379-383:—

- I. "Obituary Notice of Robert Etheridge, Jun."
- II. "The Solvent Effects of Sea-water on Limestones."
- III. "Note on the Generic Position of Certain Australian Cambrian Trilobites."
- IV. "Sarsen Stones and Drift Pumice in New Zealand."

1921. "Crinoids from the Cretaceous Beds of Australia, with Description of a New Species," vol. xlv., 1921, pp. 1-4, pl. 1.

1921. "Geological Memoranda" (Second Contribution), vol. xlv., 1921, pp. 25-35, pls. 5-7:—

- I. "Miniature Serpuline, Atolls," pl. 5.
- II. "Pseudo-Cryptozoön Structure."
- III. "A Prehistoric Alluvial Fan of Exceptional Character at the Mouth of the Glen Osmond Gorge," pls. 6 and 7.
- IV. "The Occurrence of Scoriaceous Boulders in the Ancient Gravels of the River Torrens."

1921. "On the Occurrence of Aboriginal Stone Implements of Unusual Types in the Tableland Regions of Central Australia," vol. xlv., 1921, pp. 206-230, pls. 11-21.

1921. "On the Methods Adopted by the Aborigines of Australia in the Making of Stone Implements, based on Actual Observations," vol. xlv., 1921, pp. 280-281.

1922. "A Geological Traverse of the Flinders Range from the Parachilna Gorge to the Lake Frome Plains," vol. xlvi., 1922, pp. 46-82, pl. 4.

1923. "A Geological Sketch-section of the Sea-cliffs on the Eastern Side of Gulf St. Vincent from Brighton to Sellick's Hill, with Descriptions," vol. xlvii., 1923, pp. 279-315, pls. 22-26.

1924. "Further Discoveries of Permo-Carboniferous Glacial Features near Hallett's Cove," vol. xlviii., 1924, pp. 297-302, pls. 26-28.

1925. "The Geographical Distribution of Fossiliferous Rocks of Cambrian Age in South Australia, with Geological Notes and References," vol. xlix., 1925, pp. 1-26, with Maps and Geological Sections.

1926. "The Geology of the Barossa Ranges and Neighbourhood in Relation to the Geological Axis of the Country," vol. l., 1926, pp. 1-16, pl. 1.

1926. "The Geology of Victor Harbour, Inman Valley, and Yankalilla Districts, with Special Reference to the Great Inman Valley Glacier of Permo-Carboniferous Age," vol. l., 1926, pp. 89-119, pls. 7-16.

1927. "The Sturtian Tillite in the Neighbourhood of Eden and in the Hundreds of Kapunda, Neales, and English, South Australia," vol. li., 1927, pp. 330-349, pls. 14 and 15.

1928. "The Sturtian Tillite and Associated Beds on the Western Scarps of the Southern Flinders Ranges," vol. lii., 1928, pp. 82-94.

1929. "On the Probable Occurrence of the Sturtian Tillite near Nairne and Mount Barker," vol. liii., 1929, pp. 27-32.

1929. "Notes on the Geology of the Great Pyap Bend (Loxton), River Murray Basin, and Remarks on the Geological History of the River Murray," vol. liii., 1929, pp. 167-195, pls. 6-8.

1930. "The Geology of Orroroo and District," vol. liv., 1930, pp. 159-176, pls. 8 and 9.

1931. "The Dead Rivers of South Australia, Part I.—The Western Group," vol. lv., 1931, pp. 113-135, coloured map, and pl. 5.

1933. "The Dead Rivers of South Australia, Part II.—The Eastern Group," vol. lvii., 1933, pp. 1-41, coloured map and pls. 1-4.

IX.

Linnean Society of New South Wales.

1896. "Note on the Occurrence of Casts of Radiolaria in Pre-Cambrian (?) Rocks, South Australia," by T. W. E. David and W. Howchin, vol. xxi., 1896, pp. 571-583, pls. 39 and 40.

X.

MEMOIRS OF THE GEOLOGICAL SURVEY OF NEW SOUTH WALES.

1905. "A Monograph of the Foraminifera of the Permo-Carboniferous Limestones of New South Wales," by F. Chapman and W. Howchin. Palaeontology No. 14, 1905, E. F. Pittman (Letter of Transmissal), p. vii. Stratigraphical Note, T. W. E. David, pp. ix.-xvi. Foraminifera, Chapman and Howchin, pp. 1-22, pls. 1-4.

XI.

WESTERN AUSTRALIAN GEOLOGICAL SURVEY.

1907. "Foraminifera from a Calcareous Marlstone, Gingin." Bull. 27, 1907, pp. 38-43. Mines Dept., Perth.

XII.

PROCEEDINGS OF THE ROYAL GEOGRAPHICAL SOCIETY OF AUSTRALASIA, SOUTH AUSTRALIAN BRANCH.

1909. "Geological Observations on Some of the Localities Visited by the s.s. *Governor Musgrave* Party (A.A.Ad.Sc. Adelaide Meeting) in Jan., 1907," vol. x., 1907-8 (1909), pp. 204-219, pls. 23-27.

XIII.

GOVERNMENT OF SOUTH AUSTRALIA.

1910. "Native Animals of South Australia," Department of Intelligence, Bull. 14, pp. 1-7. Govt. Printer, Adelaide.

XIV.

QUARTERLY JOURNAL OF THE GEOLOGICAL SOCIETY, LONDON.

1908. "Glacial Beds of Cambrian Age in South Australia," vol. lxiv., May, 1908, pp. 234-259, pls. 19-26.

XV.

JOURNAL OF GEOLOGY, UNIVERSITY OF CHICAGO, U.S.A.

1912. "Australian Glaciations," vol. xx., No 3, 1912, pp. 193-227. [Seven photographs reproduced.]

XVI.

SOUTH AUSTRALIAN HANDBOOK.

BRITISH ASSOCIATION, AUSTRALIAN MEETING.

1914. "Geology and Physiography of South Australia," pp. 209-244. Govt. Printer, Adelaide.

XVII.

UNIVERSITY OF ADELAIDE.

1920. Commemoration Address: "The Physical Sciences in Relation to Mental Culture." Hassell & Son, Adelaide.

XVIII.

THE OFFICIAL YEAR BOOK OF THE COMMONWEALTH OF AUSTRALIA.

1920. Special Article: "Past Glacial Action in Australia," No. 13, 1920, pp. 1,133-1,146. Govt. Printer, Melbourne.

XIX.

The South Australian Ornithologist.

1926. "Some References to the Literature concerning the Extinct Emu of Kangaroo Island," vol. viii., pt. 7, 1926, pp. 244-253.

XX.

Records of the South Australian Museum.

1928. "A New and Very Large Crioceratid Ammonoid from the Cretaceous of Central Australia." By Walter Howchin and F. W. Whitehouse, vol. iii., No. 4, May, 1928, pp. 483-492.

1933. "A Rejoinder to some Recent Ethnological Papers," vol. v., No. 1. Aug., 1933, pp. 1-11.

XXI.

The Following are Bound Volumes.

1917. "The Geography of South Australia, with an Introduction by Professor J. W. Gregory." Revised Edition, 1917. 318 pages and 76 illustrations. Whitcombe and Tombs. [Out of print.]

1918. "The Geology of South Australia (in Two Divisions):—

Div. 1.: An Introduction to Geology (Physiographical and Structural) from the Australian Standpoint.

Div. 2.: The Geology of South Australia, with Notes on the Chief Geological Systems and Occurrences in the other Australian States."

Pages: XVI. and 543, with 330 illustrations, Govt. Printer, Adelaide. [Out of print.]

1920. "An Introduction to Geology, Physiographical and Structural, being Division I. of the Geology of South Australia." Reprinted separately. Pages V. and 340, with 258 illustrations. Govt. Printer, Adelaide. [Out of print.]

1929. "The Geology of South Australia, with Notes on the Chief Geological Systems and Occurrences in the other Australian States." Second Edition Revised and Enlarged, 1929. Pages XV. and 320, with 157 illustrations. Gillingham & Co. Limited, Adelaide.

Handbooks of the Flora and Fauna of South Australia, issued by the British Science Guild (South Australian Branch), and Published by favour of the Honourable the Premier.

1925-1930. "The Building of Australia and the Succession of Life, with Special Reference to South Australia." In Three Parts. Pages: XII. and 750, with 274 Illustrations:—

Part I. The Pre-Palaeozoic and Palaeozoic Divisions, pp. 1-203.

Part II. The Mesozoic Divisions, pp. 205-339.

Part III. The Cainozoic (or Tertiary) Divisions, pp. 339-750.

[The three Parts can be had separately.] Govt. Printer, Adelaide.

W. H.

GENERAL INDEX.

[Generic and specific names in italics indicate that the forms described are new to science.]

Fig. 1. Ancient Alluvial Plateau between Hutt and Hill Rivers. East Escarpment.

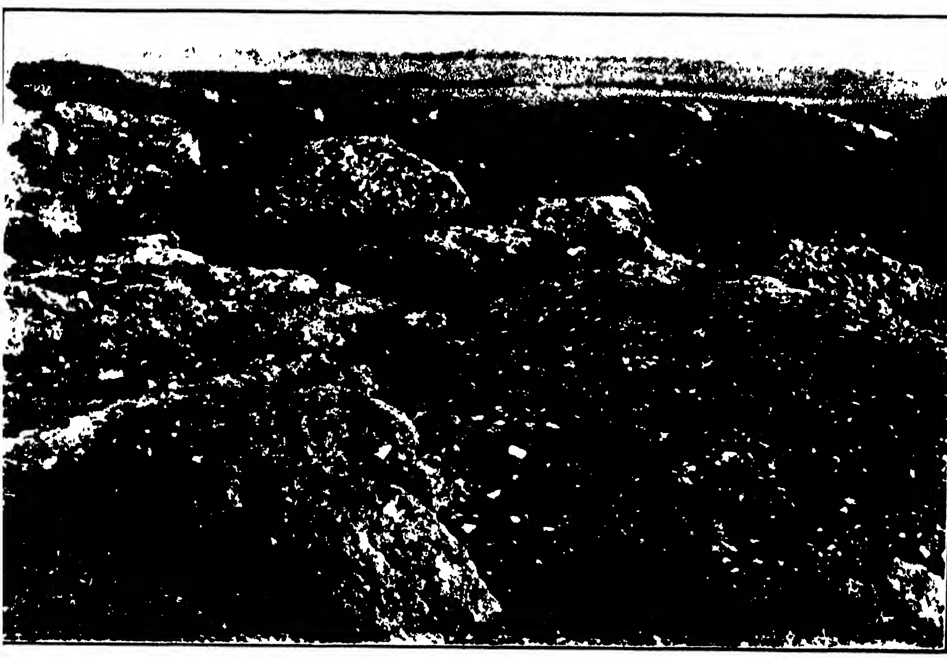


Fig. 2. Plateau of Consolidated Alluvium, as in Fig. 1. General View.

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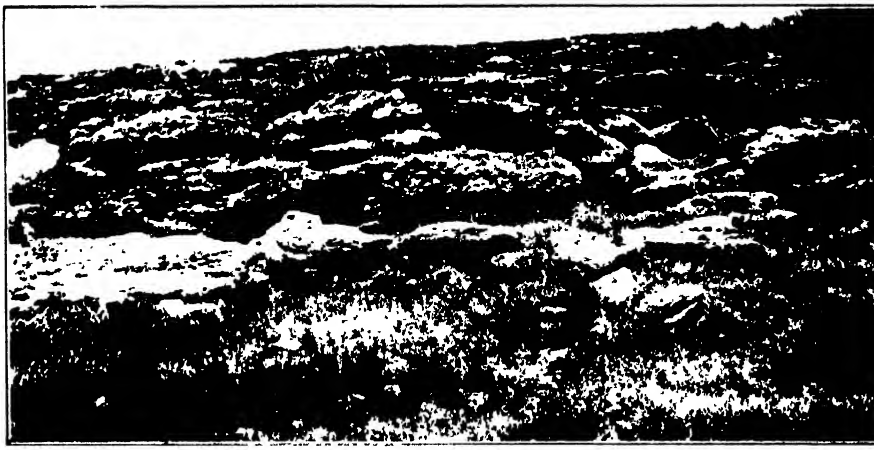

Fig 1. Ancient River Plateau, west of Stockport. Eastern Escarpment.

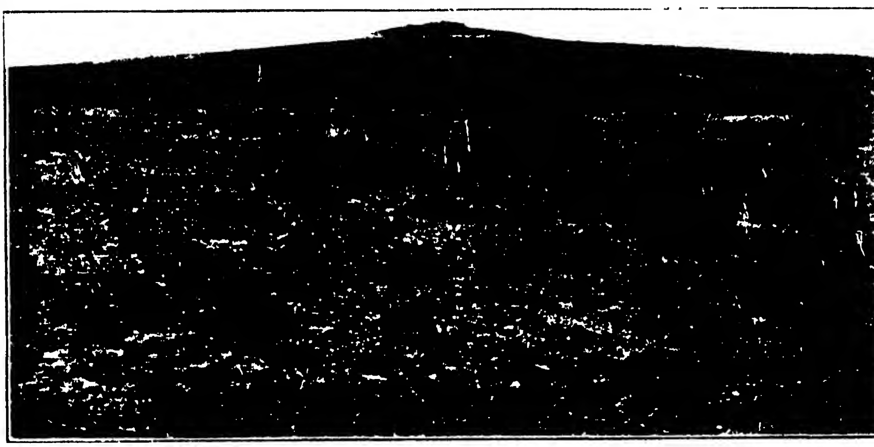

Fig 2 High-level River Terrace, east of Stockport Distant view.

Fig. 3. Alluvial Capping on top of hill. Same as Fig 2. Near view.

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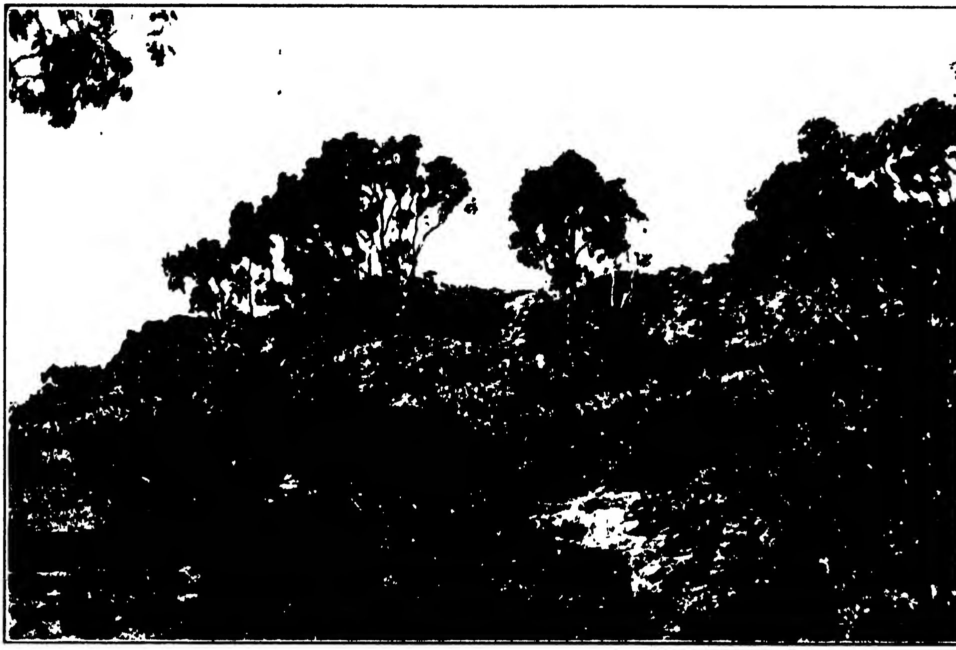

Fig. 1 Escarpment of Ancient River Terrace near Anstey's Hill, Hope Valley.

Fig. 2 Old Consolidated Alluvium unconformably on Decomposed Slates. Blackwood.

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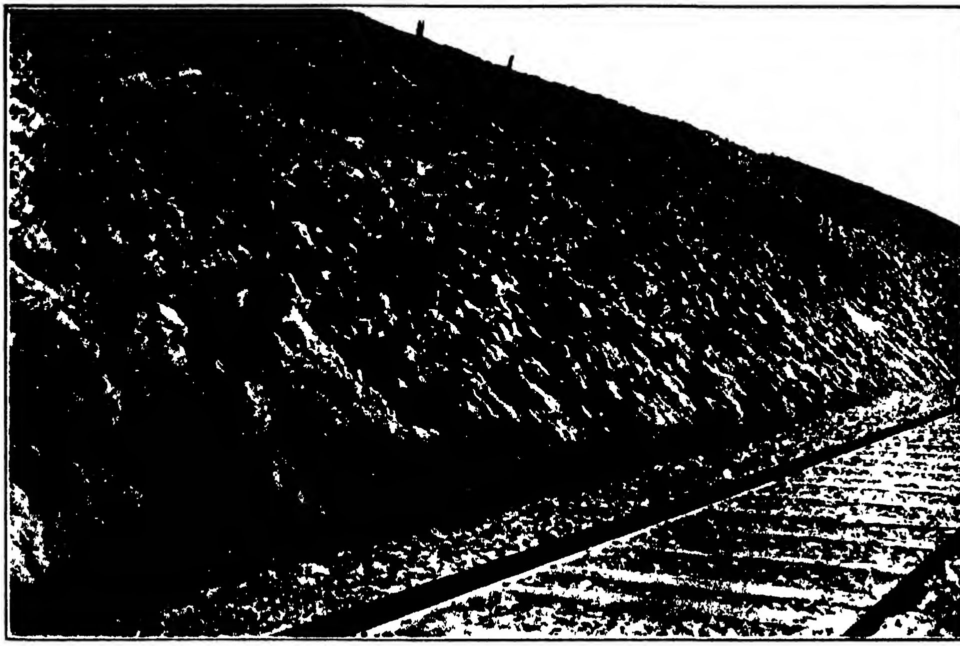

Fig 1 Ancient Alluvial Sand rock Railway cutting near Morphett Vale.

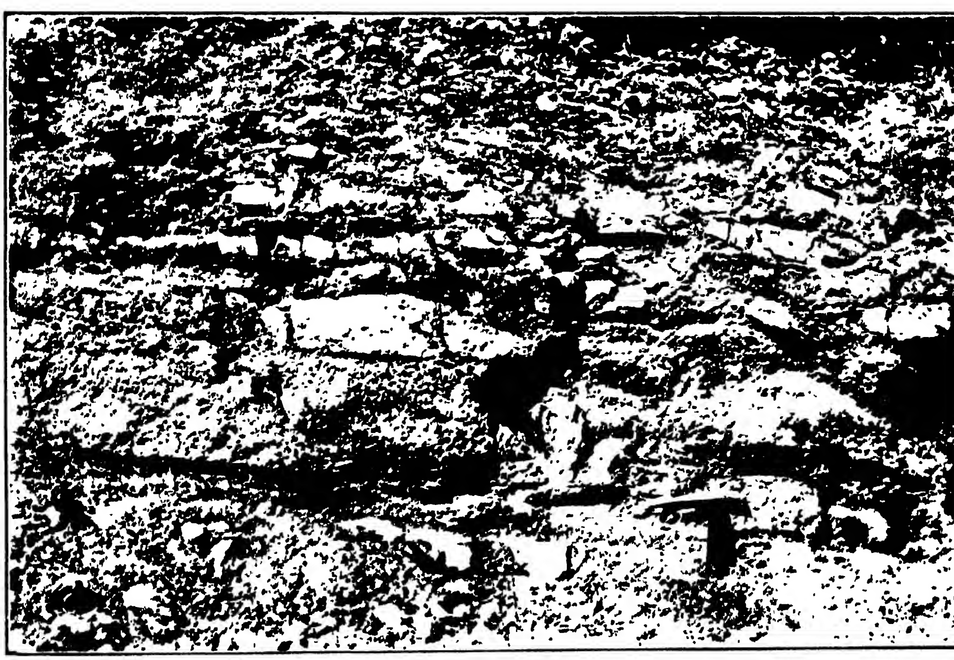

Fig. 2. Ancient Gravels resting unconformably on Miocene. Railway, Hackham.

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Fig. 2.

Fig. 1.

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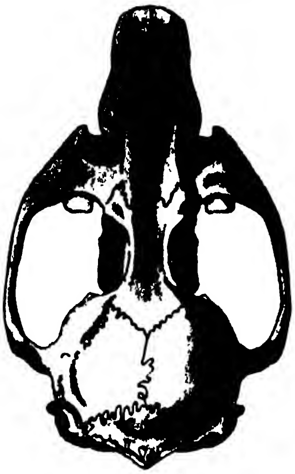

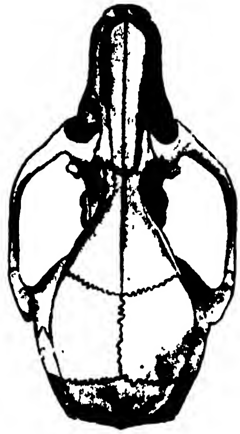

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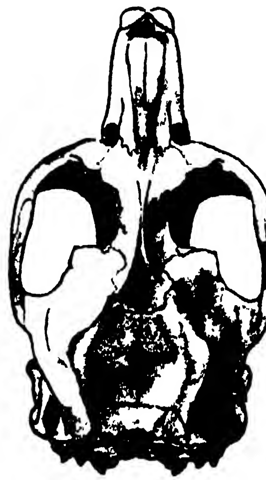

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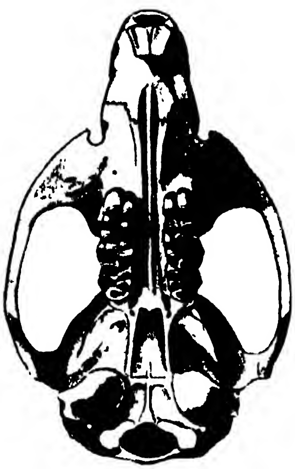

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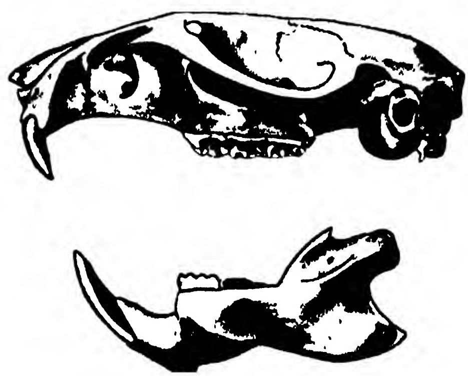

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H x 1½

F x 2

I x 2

J x 1½

Del. H. T. Condon

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Photo by H. H. Finlayson

Cradle Valley, North-west Tasmania

A view from the north, showing features of the country in which *Mastacomys fuscus* still survives.

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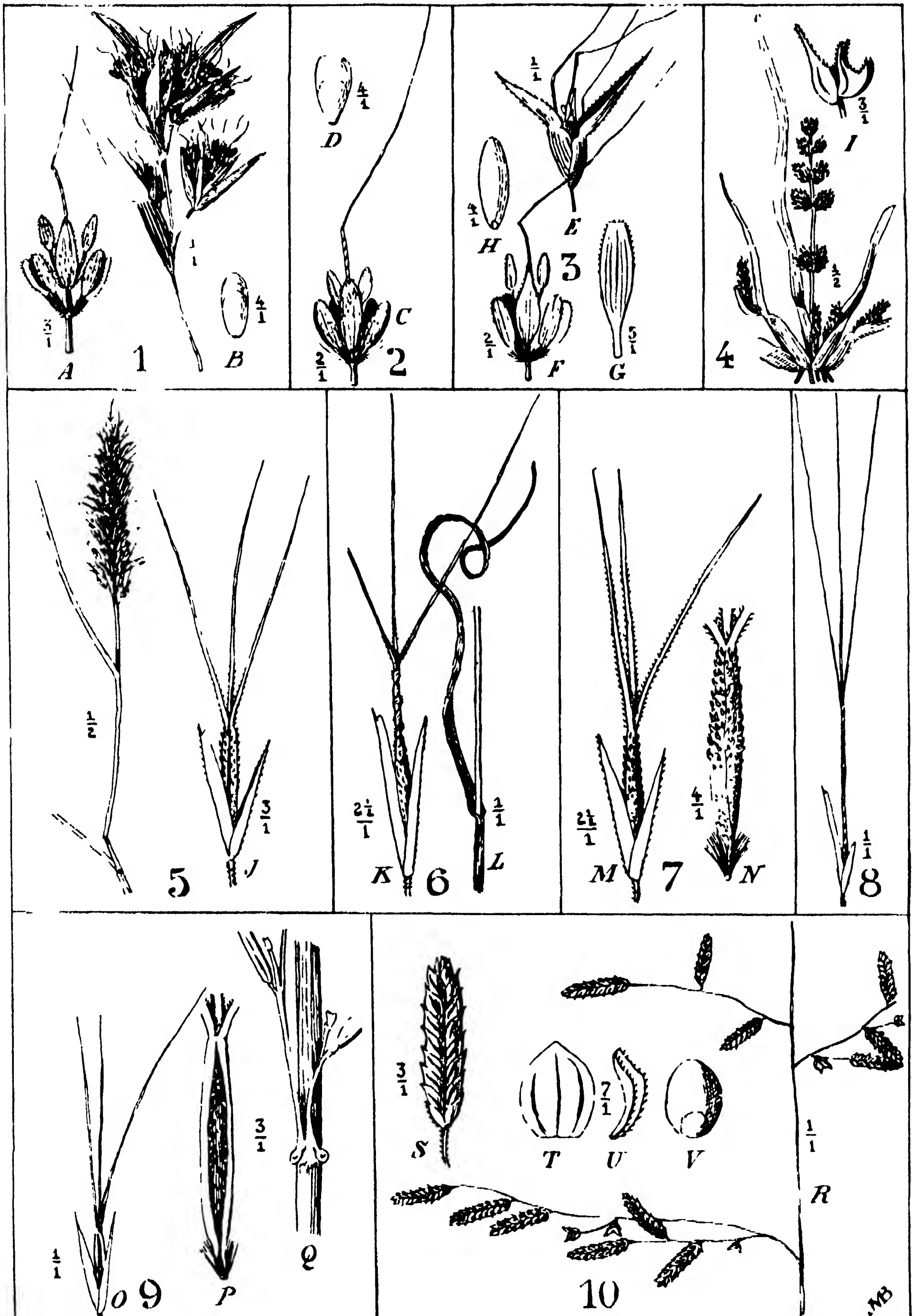

1 *Iseilema actinostachys* 2. *I. membranacea.* 3. *I. vaginiflora.* 4. *Elytrophorus spicatus.* 5. *Aristida anthoxanthoides* 6. *A. latifolia* var *minor* 7. *A. echinata.* 8. *A. Browniana.* 9. *A. biglandulosa.* 10. *Eragrostis elongata.*

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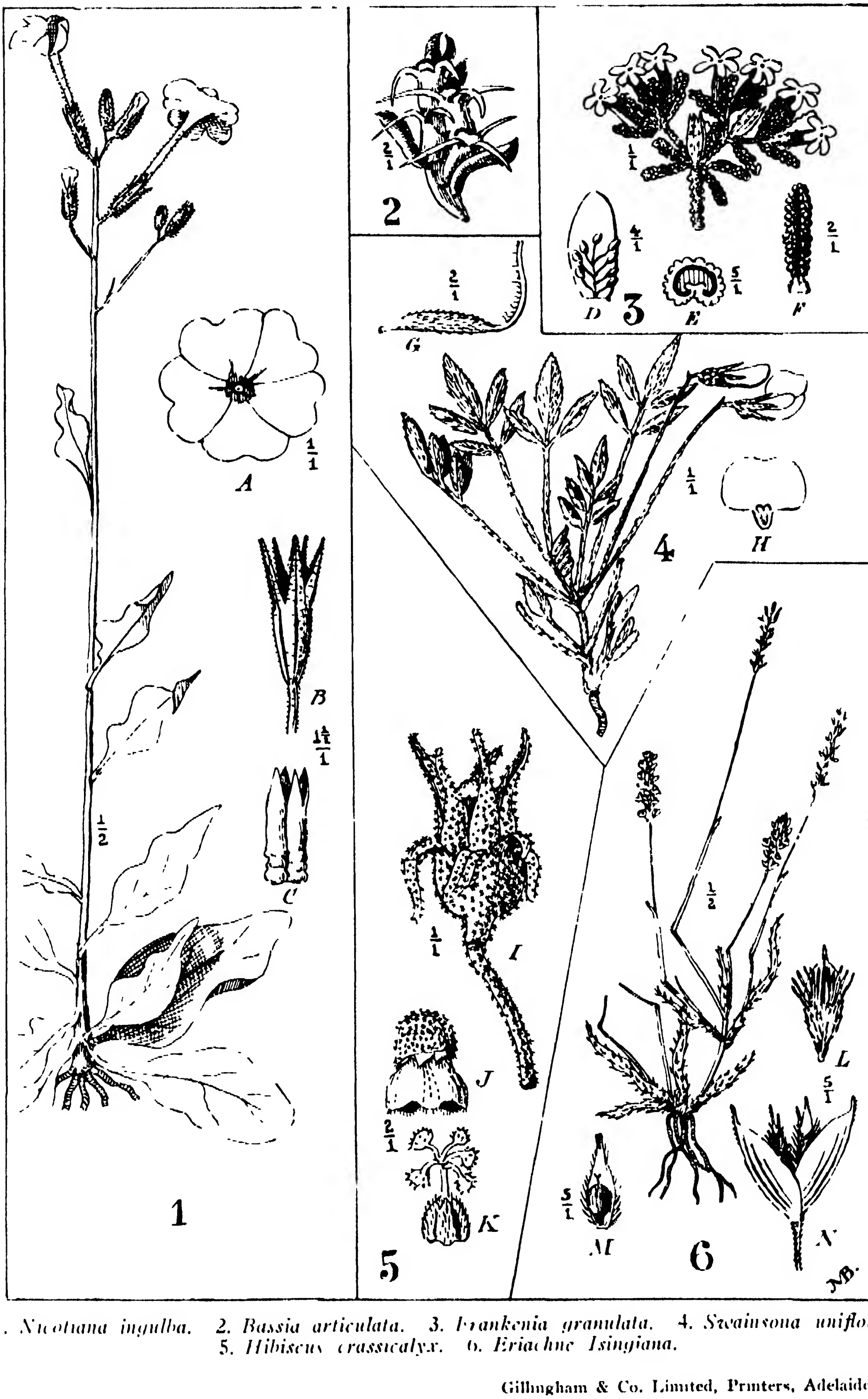

1. *Nicotiana ingulba.* 2. *Bassia articulata.* 3. *Frankenia granulata.* 4. *Swainsona uniflora.* 5. *Hibiscus crassicalyx.* 6. *Eriachne Isingiana.*

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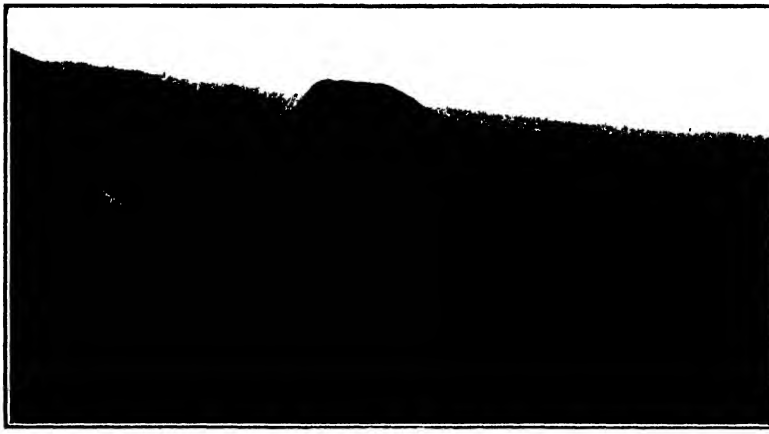

Fig. 1.

Fig. 2.

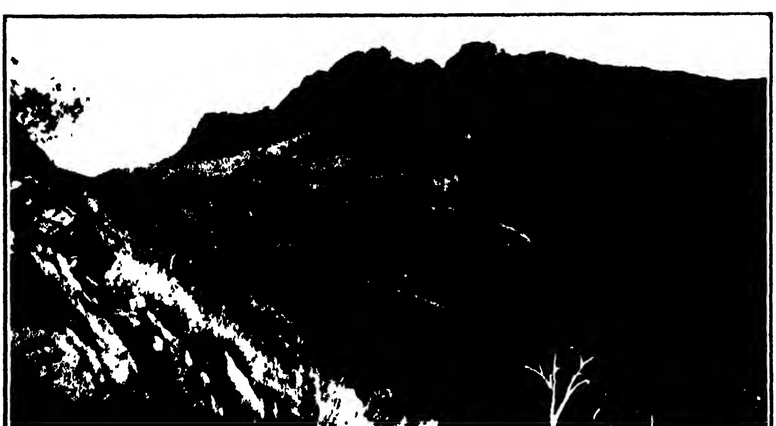

Fig 3.

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OF THE

ROYAL SOCIETY OF SOUTH AUSTRALIA

(INCORPORATED)

VOL. LVIII.

[WITH PORTRAIT, TEN PLATES, AND THIRTY-TWO FIGURES IN THE TEXT]

[*Each Author is responsible for the soundness of the opinions given, and for the accuracy of the statements made in his paper.*]

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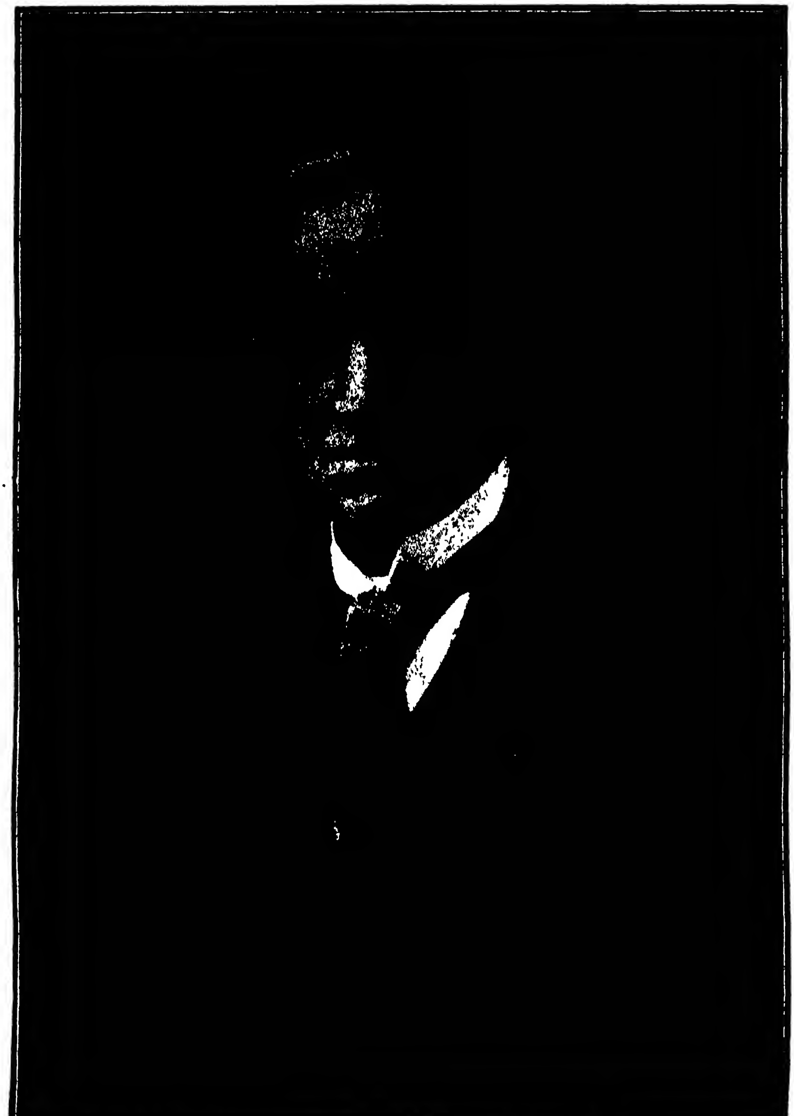
CONTENTS.



SIR TANNATT WILLIAM EDGEWORTH DAVID, K.B.E., C.M.G., D.S.O., D.SC., ETC.

OBITUARY NOTICE.

SIR TANNATT WILLIAM EDGEWORTH DAVID. K.B.E., C.M.G., D.S.O., D.Sc., F.R.S., etc. (1858-1934).

WITH PORTRAIT AS FRONTISPIECE.

The sudden passing of Sir Edgeworth David has brought to a close a life of extraordinary activity that found spheres of usefulness in manifold directions, and has left a vacancy in the scientific ranks of Australia that is very difficult to fill.

The subject of our Obituary Notice was the son of the Rev. William David, M.A., rector at St. Fagan, a small village situated about five miles from Cardiff, in South Wales. He was born at the Rectory in 1858, was educated at Magdelen College School and New College, Oxford, where he distinguished himself both in his studies and in athletics. His father had a predilection for fossils, and made a valuable collection of these from the surrounding country, which was noted for such remains. He caught his first enthusiasm for geology from Prof. Sir Joseph Prestwich, whose lectures he attended and took advantage of the presence of members of the British Geological Survey, who were stationed in his neighbourhood, to get initiated into the methods of geological field work. He graduated as Bachelor of Arts in 1880, and obtained a First Class in Classics in the Honours Examination.

It was in South Wales that he found his first insight into the evidences of extinct glacial action, which came as a revelation to him from the moraines and erratics of his native land. He was the first field geologist to make such local and detailed observations, and he embodied his notes in his first scientific paper read before The Cardiff Naturalists' Society, in 1881, which was followed by more extended notes published in the Journal of the Geological Society of London, in 1883, of which Society he had been elected a Fellow the same year.

In 1882 the office of Assistant Geological Surveyor in New South Wales was vacant, and enquiries were made in England as to suitable candidates, and on the recommendation of Prof. Sir Joseph Prestwich and Prof. Boyd Dawkins, David was appointed to the office, at 24 years of age. He entered with great zest into the discharge of what was to him congenial duties, stimulated by the new aspects of geology that were before him in these southern lands.

As a Geological Surveyor under Government control he was required to give special attention to such branches of the subject as had an economic value, and the nine years he spent in the Public Service were spent mainly in that direction, but he invariably based his work on sound scientific principles. Among the more important monographs that he published during this period were: "The Geology of Vegetable Creek Tin-Mining Field, New England District, with Maps and Sections," a most exhaustive work; and the still more important monograph on "The Geology of the Hunter River Coal Measures, with Maps, Plates, and Sections"; a great work in which the author not only elaborated those parts of the coal resources of New South Wales that were already known, but was successful in the discovery of coal deposits where they had not been previously suspected to occur, and gave rise to the development of the important group of collieries based on the Greta Coal Measures.

In 1891 the University of Sydney wisely considered that a geologist of such exceptional abilities and enthusiasm could find a more extended usefulness as the occupant of a professorial chair in the University, and was justified in this by the happy results that followed. Professor David possessed not only an unlimited enthusiasm in the pursuit of his favourite subject, but by a personal magnetism infused the same spirit into his students, who came to look upon their studies not as tasks but as fascinating researches into the hidden paths of Nature.

One of the distinctve features of his mental tendencies was the power of generalization. He was not satisfied to take in the geological evidences of a single locality, but he immediately sought to correlate one geological region with others, and thus established definite geological provinces which took in all the States. In this aspect of his work he may be regarded as the Suess of Australia, for all the States have benefited by his constructive methods.

The British Expedition to Funafuti, in 1886, to test the validity of Darwin's theory of coral reefs, having failed to reach any considerable depth, the University vacation in the following year presented the opportunity for an Australian Expedition, under the leadership of Professor David, to make a second attempt; after a depth of about 600 feet had been reached, the University contingent had to return to duties in Sydney. Later, the boring was continued under the direction of Mr. A. H. Halligan, of Sydney, and was successful in reaching a depth of over 1,100 feet. The persistent advocacy of this object and its successful accomplishment were largely due to Professor David's enthusiasm, towards the cost of which he had largely contributed from his private means.

The fascinating subject of past glacial action in low latitudes, which began in his experience while still a lad, held him in its spell all the rest of his life. In 1897 he suggested to the writer that an attempt should be made to locate the glaciated rock in the Inman Valley discovered by Selwyn, in 1859. By arrangement we joined in this excursion, and although the actual polished rock seen by Selwyn was not seen (that came later) other glaciated faces were discovered, and many immense erratics located on the hillsides, which abundantly confirmed Selwyn's determination.

But the greatest thrill that came to him, in this particular aspect of his science, was the announcement by the writer that he had discovered an ancient tillite in rocks bordering on the Pre-Cambrian Age. The Professor took the earliest opportunity of visiting the evidences in the valley of the River Sturt and in the ranges near Petersburg. Many other visits were made to South Australia, and I have never seen him in a greater state of excitement than when handling a polished and ice-scratched erratic taken freshly out of the tillite. He concentrated much attention on the boulder-bearing beds that are interbedded with the Coal Measures of New South Wales, tracing them down through the Permian series to the Carboniferous. He elucidated the wonderful Permo-Carboniferous glacial deposits in Tasmania; when there was a warm dispute as to whether glaciers formerly lined the sides of Kosciusko, his examination of the field, descriptions, photographs, and measurements, made under even some risk to life, is a classic in this subject. Not content with the Australian evidences of Permo-Carboniferous glaciations—the greatest of all Ice Ages that the world has seen—he paid a visit to Central India to examine the Talchir Tillites (which are also classed as of Permo-Carboniferous Age), a visit that, unfortunately, had to be taken

in the rainy season, which involved much hardship and even serious risks from the flooded states of the rivers.

On two other occasions than the Selwyn episode mentioned above, Prof. David was called on to investigate glacial questions in South Australia. One of these concerned the geological age of the Hallett's Cove glaciation. Prof Tate had advocated that this glaciation was post Miocene. A visit to the spot by the members of the Australasian Association for the advancement of Science, in 1893, gave rise to a lively discussion on the subject, and the Association, in Council, passed a grant of money to clear up the question. In the following year Prof. David took charge of the operations, which involved the clearing away of the talus that had obscured the stratigraphical relationship of the tillite with the associated fossiliferous rocks, the result being the clearest proof that the glacial beds underlaid the fossiliferous Lower Pliocene (Tate's "Miocene"). The other occasion in which Prof. David was delegated to investigate reported glacial evidences in South Australia, arose out of conflicting testimonies as to whether there was, or was not, such evidences at Crown Point, on the Finke River, in Central Australia. The Australasian Association having set apart a small monetary grant for investigation, and authorised Prof. David and the writer to undertake the expedition, the locality was visited in 1922, with the result that the glacial evidences (of assumed Permo-Carboniferous Age) were much more extensive and convincing than had previously been recognised.

The absorbing interest that the Professor took in glacial questions led him to join Shackleton's First Expedition to the Antarctic (1907-9), and at the age of 51 faced the rigours of an Antarctic winter and took his full share in the daily duties of the Expedition. He was one of the party that climbed Mount Erebus and gazed into its ancient crater; he was also the leader of the party that discovered and located the position of the South Magnetic Pole. His official report, as Geology, vol. i., of the Expedition, is one of the most comprehensive, profusely illustrated, and interesting volumes in the literature of the Antarctic.

At the outbreak of the Great War his loyal enthusiasm and fruitful resources led him to play his part in that great struggle. Too old to join the ranks, he joined the corps of Mining Engineers of the A.I.F., under Lieut.-Colonel Fewtrell, in the rank of Major, as geological expert, and at the same time used his influence in securing the addition of many of the University students to this branch of the army. The accomplishments of this corps, not only in effecting the tremendous Messines explosion that did such damage to the enemy's lines, but also on the vital questions of underground waters, and their seasonal variations in the great chalk beds, having the most vital bearings on tunnelling and underground safety; in all these matters the expert knowledge of the Professor was of the highest value, and for this he was mentioned in Dispatches. It was in the discharge of these duties that Prof. David met with his serious accident by falling down a shaft, 80 feet deep, and received injuries that caused increasing disabilities and suffering throughout the rest of his life, and no doubt hastened his end.

During the latter part of his life (it may safely be said that for at least ten years) Prof. David had begun systematically to collate the geological data of the Australian continent in a connected whole, for which his great powers of generalization were eminently adapted. Concurrently with his preparation of a detailed Geology of the Commonwealth, which was intended to take the form of a three volume work, he was intently engaged in producing a detailed geological map of the whole of Australia, which, fortunately,

was completed and published during his life time. The President of the Geological Society of London (Sir Thomas H. Holland), in his Anniversary Address, just published, stated, "Australia alone among the Dominions has no Commonwealth Geological Survey. Providence has, however, lent it temporarily the services of Sir Edgeworth David, who is possibly the only man living who could have correlated the scattered State records to produce a geological map of the whole Commonwealth like that which he published two years ago." Together with this great map is published a volume of "Explanatory Notes," which supplies a key to the map, and at the same time a summary of the most trustworthy and up-to-date facts relating to the geology of Australia as a whole. Unfortunately the author had not lived to see his great work published, but, fortunately, it is left so near completion that, it is hoped, those of his colleagues who have collaborated with the author in finalizing his efforts will be able to see it through the press practically as the author desired.

Sir Edgeworth David's distinguished scientific qualities were associated with great personal charm. To render a service to others, whether in friendship or in scientific helpfulness, gave him the greatest of pleasure. The very generous way in which he always recognised the work of others who may have been over the scientific field before him, won the hearts of his colleagues and stimulated the efforts of his students. He was a most welcome guest and delightful companion. With a rich anecdotal lore, largely drawn from his own experience, and given in an inimitable style, his conversation was full of interest and character.

He participated in many well-deserved honours. From Royalty he received his C.M.G. in 1910; D.S.O. in 1918, and K.B.E. in 1920. He was awarded the Conrad Malte-Brun Prize by the Geographical Society of France; the Wollaston and Bigsby Medals by the Geological Society of London; the Müeller Memorial Medal by the Australasian Association for Advancement of Science; the Clarke Memorial Medal by the Royal Society of New South Wales; he was elected an F R.S. in 1900; Hon. D.Sc. (Oxen.) in 1911; an Hon. Fellow of this Society in 1897; was twice President of the Aus. Assoc. Ad. Sc. (a unique honour); and President of other learned societies and scientific movements in various parts of Australia.

The Members of the Royal Society of South Australia mourn their loss, and tender to Lady David and the other members of his bereaved family its most heartfelt sympathies.

W. HOWCHIN.

October, 1934.

Transactions
of
The Royal Society of South Australia (Incorporated)

VOL. LVIII.

THE ARLTUNGA AND KAROONDA METEORITES.

By D. Mawson, Kt., D.Sc., F.R.S.

Plates I. to III.

[Read November 9, 1933.]

I. The Arltunga Meteorite.

This siderite was found by Dan Pedler about the month of September, 1908, and came under notice of the Mines Department. The Government Geologist, the late Mr. H. Y. L. Brown, referred the discoverer to the South Australian Museum, with the result that the meteorite was purchased by that institution in November of the same year. The find was located some two miles south of the Government Cyanide Works at Arltunga, a mining centre in the eastern end of the MacDonnell Ranges, Central Australia. The geographic position may be taken at latitude 23° 28′ S. and longitude 134° 40′ E.

The iron mass was reported to have cut its way obliquely into the ground for a depth of about five feet, excavating a groove, at one end of which it was seen to be embedded with but a small corner projecting from the soil. It was not seen to fall, but must have arrived within a short time of its discovery—certainly not more than several years, and probably considerably less—else the groove scored in the ground would have become obliterated by wind-blown sand and wash. The date of the fall may, therefore, be placed at about 1907-1908.

The weight of the original entire meteorite amounted to almost exactly forty pounds. It is of a solid squat shape with a flat base 26 cms. by 16 cms., from which it rises as an irregular tapering form to a blunt ridge 14 cms. above the base. The surfaces are generally smooth (pl. ii., fig. 1) there being no definite pits, only broad, shallow depressions and convexities. It may have traversed the atmosphere with the flat base to the rear, but there is no evidence, by markings on the surface, of the direction of passing air currents. Also there are no markings definitely indicating the point of impact with the ground.

The surface of the metal is cased in a very dark-coloured oxidization (by heat) crust, magnetite, under one millimetre in thickness. This is surmounted, here and there, by patches of a thin reddish oxidization veneer resulting from further oxidization by weathering.

The specific gravity of the unoxidized meteorite material was ascertained to be 7·848, and an analysis made by Mr. W. T. Chapman, late analyst to the Mines Department, gave the following result:—

Iron (Fe) - - - - -	88·06%
Nickel (Ni) - - - - -	10·22%
Cobalt (Co) - - - - -	1·01%
Chromium (Cr) - - - -	0·26%
Phosphorus (P) - - - -	0·24%
Sulphur (S) - - - -	not det.
Insoluble in *aqua regia* - - -	0·01%
Total -	99·

An examination of polished plates viewed under the microscope establishes the fact that almost the entire mass is composed of nickel-iron alloys, there being only minute quantities of other substances. A few tiny patches, circular in outline and not exceeding 0·5 mm. diameter, are visible occupied by a brittle, black substance which is non-magnetic and dissolves in dilute nitric acid with the evolution of some hydrogen sulphide. This mineral is taken to be daubréelite, a double sulphide of iron and chromium. Further, an acid etch brings into relief scattered minute grains of a tin-white, metallic mineral very resistant to the solvent. These grains are evidently schreibersite, a phosphide of iron, nickel and cobalt.

Polished plates, when etched with very dilute nitric acid, become finely frosted in appearance (pl. i., fig. 1). To the naked eye there is no evidence of Widmanstätten figures or other coarse structure, though the percentage of nickel plus cobalt falls within the usual range of octahedrites. Lack of macroscopic structure is sufficient to relegate this siderite to the group known as ataxites. However, upon further investigation of the etched surface at high magnification, the existence of an interesting micro-structure is revealed. Thus at 100 times the actual dimensions (pl. i., fig. 2) rods and blebs of a brightly reflecting nickel-iron alloy moderately resistant to the attack of dilute acid are seen to be arranged in definite microscopic pattern. At 200 diams. (pl. i., fig. 3) the octahedral character of the pattern is clearly defined. At 500 diams. (pl. i., fig. 4) the more intimate nature of the arrangement is revealed. The texture is seen to be chiefly defined by the alignment of most of the nickel-iron alloy richest in nickel (apparently taenite) in octahedral fashion. The bulk of the intervening material is a microscopic intergrowth of some taenite with a duller, more soluble ferro-alloy of lower nickel content, probably of the general composition of kamacite.

The several constituents appear to be represented in the following approximate proportions:—

Kamacitic nickel-iron - - -	65%
Taenitic - - - - - -	33%
Daubréelite - - - - - -	$\frac{2}{3}$%
Schreibersite - - - - - -	$\frac{1}{3}$%

The etched plates do not reveal any obvious suppression or modification of the crystalline structure in the marginal zone adjacent to the skin of the meteorite. In the case of meteorites exhibiting coarse Widmanstätten figures within, the structure often fades out in proximity to the margin, a feature ascribed to molecular re-arrangement under heat stress as it traversed the atmosphere.

The question arises as to whether the micro-octahedral structure of this meteorite is of primary or secondary origin. It can be conceived as possibly developed as a secondary structure from an original normal octahedrite that has recrystallized in the solid state under some degree of reheating. In this case the octahedral orientation of some of the elements would be of the nature of a "relict" structure analogous to phenomena met with in the case of certain metamorphosed rocks.

With regard to classification, two alternatives are suggested. Siderites with the structure here represented may be regarded either as a variety of the ataxites; or else classed under the term micro-octahedrites, as a special division of the octahedrites.

II. The Karoonda Meteorite.

The Karoonda meteorite is an aerolite of uncommon type. Interest in it is further increased by reason of its fall having been observed, and the phenomena associated therewith having been ably recorded[1] by Professor Kerr Grant and Mr. G. F. Dodwell. It was observed to arrive as a brilliant fireball, witnessed over a radius of more than 250 miles in southern South Australia, at about

(1) "Nature," 1931, vol. cxxvii., p. 402-403.

10.53 p.m. on the evening of November 25, 1930. After examining the evidence, Grant and Dodwell conclude that "the meteorite appears to have descended at a steep angle of about 70° with the horizontal. When first seen it had an altitude of 150 miles or more, and the duration of the fall was approximately six seconds. It travelled in an east-south-east direction.

"When first seen the meteorite compared in brightness with a star of first or second magnitude but rapidly (in a few seconds) increased to a brilliancy which gave an illumination comparable to that of daylight, even in Adelaide. It was described by many observers as an immense ball of bluish-white colour, equal in diameter to the full moon, and having a luminous tail several degrees in length. As it approached the earth showers of sparks issued from the main body."

Observers within a few miles of the location of the fall reported a loud rumbling or roaring noise. Messrs. Honeyman and Millard, of Karoonda, who were nearer to the locality of the fall than any other observers (2¼ miles distant), give the following account:—". . . the disappearance[2] of the meteorite was followed by a loud detonation as though a very heavy charge of explosive had been let off underground. This caused a distinct vibration of buildings nearby. This sound was followed, at an interval of about three seconds, by a loud cracking and rending sound from the sky in the direction in which the meteorite was last seen, then by a low rumbling of thunder which gradually died away in the distance."

Visible and audible phenomena pointed to impact having taken place in the vicinity of Karoonda, and with a view to retrieving the meteorite, Professor Kerr Grant and Mr. Dodwell led a search party from Adelaide. On the third day of search they were successful in locating the fall at a point 2¼ miles east of the township of Karoonda. The meteorite was lying in sandy farm land. "It had made a crater-like hole in the sand eighteen inches in diameter and about the same depth, with a surrounding ridge of sand three feet six inches across."

"The meteoritic stone had shattered on striking the earth, and numerous fragments were scattered over a radius of four or five feet. The bulk of its mass, however, was within the crater, the largest fragments being on the east side and pointing nearly vertically down. In addition to pieces varying from an ounce or two to seven pounds in weight, there were very numerous smaller fragments and much finely pulverized material mixed with sand. The whole was collected and the meteoritic material separated from the sand in a magnetic separator. The total weight of the meteorite was thus ascertained to have been 92 pounds."

As it was shattered on impact, the original shape of this meteorite is not known. One large fragment exhibits portion of two original faces. The illustration (pl. ii., fig. 2) shows the appearance of these two faces respectively, and the edge along which they meet. The deeply scored nature of the face exposed to the rush of air is very noticeable, as it is seamed with deep, oval pittings. The other smooth face was evidently in the rear of the advancing meteorite. Just around the edge where the side and rear face meets is a thickening of the scoriaceous crust, representing an accumulation of fused matter swept back from the friction-stressed, forward-facing part of the mass.

The fused crust is of a dark grey to nearly black colour, being distinctly blacker on the rear face, where it is thicker. It usually exceeds 1 mm. in thickness on the latter face, whilst on the forward faces it is scarcely more than a varnish, being everywhere less than 0·5 mm. in thickness. It is, everywhere, only loosely adhering to the meteorite substance within, so that it readily scales off.

The material of the meteorite itself is of a medium- to dark-grey colour, and is rather friable. This friability is doubtless due, at least in part, to the effect of

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(2) Cessation of luminosity due to impact with the ground. (D. M.)

its violent impact with the ground. Porosity is more marked than in the case of normal terrestrial rocks, but this may be due to the shattering effect of shock. No obvious nickel-iron is observable in the microscopic examination. It is practically an all-stone meteorite with abundant rounded chondri which on fracture faces (pl. iii., fig. 1) stand in relief, the chondri not breaking with the matrix.

Mr. A. R. Alderman, M.Sc., has made for the South Australian Museum a complete chemical analysis, indicating the following percentage composition:—

Silica (SiO_2)	34·36
Alumina (Al_2O_3)	5·55
Ferrous oxide (FeO)	26·99
Magnesia (MgO)	24·85
Lime (CaO)	2·58
Soda (Na_2O)	0·71
Potash (K_2O)	0·26
Water (H_2O)	0·13
Titania (TiO_2)	trace
Phosphorus Pentoxide (P_2O_5)	0·25
Ferrous sulphide (FeS)	3·98
Manganous oxide (MnO)	0·21
Chromic oxide (Cr_2O_3)	0·49
Carbon (C)	0·08
Iron (Fe)	0·42
Nickel (Ni)	0·02
Total	100·88

In this analysis the carbon was determined by F. L. Winzor, B.Sc., and the phosphorus by R. G. Thomas, B.Sc.

A specific gravity of 3·5 was obtained as the mean of several determinations. In each case the meteorite fragments were first boiled in distilled water under reduced pressure, in order to eliminate the effect of the porosity of the meteorite.

The microscope section reveals a very fine-grained, brecciated structure with abundant chondri scattered through the mass. As seen in the microscope slide, some of the chondri are perfectly circular in outline (pl. iii., fig. 2), others are subcircular, and all are more or less rounded in outline. The mineral particles composing the chondri usually appear as granular aggregates, but some are radial lamellar in structure. Chrysolite is the principal constituent of the chondri. There is always present in some quantity an impregnation of troilite, which substance is prone to be concentrated around the borders of the chondri.

The brecciated material composing the bulk of the aerolite contains some larger recognisable mineral fragments set in a denser base. The latter consists of small mineral particles, rendered dusty and more or less opaque by abundant impregnations of troilite, also scattered black opaque specks representing chromite, some magnetite and what seems to be carbonaceous matter.

Though crumbled chrysolite composes most of the base, there is some dusty glass and faintly doubly refracting mineral. Occasional particles exhibit faint polysynthetic twinning. The best example of this kind has the optical properties of a basic plagioclase. Acid attacks the weakly refracting mineral and it appears to be in the main some relative of the melilite group. The evidence of the microscope slide, therefore, is that the bulk of all the alkalies, lime and alumina are combined with silica to form a little plagioclase felspar and larger quantities of an unsaturated silicate and (or) glass with a melilite-like composition.

The iron and magnesium is almost entirely present in the form of a highly ferriferous chrysolite. There are however, in small amount, particles appearing

to have lower double refraction and a higher resistance to acid, which qualities suggest hypersthene. The latter has the same straight extinction and sign as has the ferriferous olivine.

These observations, considered in conjunction with the analysis, suggest the percentage composition to be roughly as follows:—

Chrysolite (and perhaps a little hypersthene)	82
A melilitic and felspathic fraction, say	12
Troilite	3·98
Chromite	0·67
Apatite	0·67
Nickel iron	0·44
Amorphous carbon	0·08
Magnetite, little but uncertain	?
	99·84

As to the classification of this aerolite, if catalogued on the Rose-Tschermak-Brezina system[3] it might be distinguished as a friable, dark grey, chassignitic chondrite; the chondri not breaking with the mass and nickel-iron almost wholly absent.

Recognising, however, that this system of classification, so far as the division of the chondrites is concerned, is unsatisfactory,[4] it would seem that a more simple treatment of chondritic aerolites can be applied. The division of aerolites into two main groups, sideritic and asideritic, respectively, would be a first step. The term asiderite has been applied[5] to aerolites that contain no (or only traces of) metallic iron. Prior's scheme of classification for the sideritic chondrites would then apply so far as that division is concerned. The asiderites could then be listed as chondritic or achondritic, and further divided on the basis of mineral content or of relative values of the principal chemical constituents. Simply described, ours would be a chondritic asiderite.

DESCRIPTION OF PLATES.

Plate I.

Polished and etched slice of the Arltunga meteorite, viewed at various magnifications, illustrating its micro-octahedral character.

Fig. 1. General view of the surface, twice natural size. The effect of the etching has been merely to develop a dull, fine frosting of the surface, as generally exhibited by ataxites. Note that some trace is still visible of fine scratchings due to imperfect polishing.

Fig. 2. Magnification, 100 diams. A directional structure, though on a minute scale, is now visible.

Fig. 3. Magnification, 200 diams. The taenitic elements are seen to follow a definite octahedral arrangement.

Fig. 4. Magnification, 500 diams. The taenitic rods are seen to form an octahedral skeleton embedded in a directionless kamacitic nickel-iron alloy low in nickel content.

Plate II.

Fig. 1. Shows the surface appearance of the Arltunga meteorite. The discoverer, when testing his find with a sledge hammer, was responsible for the small flat spot on the left top edge of the picture. The mark of a boring tool, employed for further testing the nature of the discovery, is also visible near the top edge towards the centre of the

(3) "Meteorites," Farrington, p. 198.

(4) "On the Genetic Relationship and Classification of Meteorites," by G. T. Prior. Min. Mag., vol. xviii., No. 83, p. 26.

(5) *Vide* Lacroix, A.; Min. Abstracts, vol. v. (1932), No. 1, p. 11.

picture. The comparatively smooth surface and absence of deep corrosion pits is to be remarked. The reproduction is about three-sevenths natural size.

Fig. 2. Illustrates the appearance of portion of the outer skin of the Karoonda meteorite. The view includes the junction of a scoria-coated, smooth face and a deeply scored face. The former was evidently at the rear of the aerolite when in flight, the latter was a forward-facing side exposed to the rush of air when traversing the atmosphere. A patch in the right-hand top corner is a natural fracture surface. Magnification: x $^7/_8$.

PLATE III.

Fig. 1. Illustrates the appearance of a natural fracture-surface exhibited by a fragment of the Karoonda meteorite. Note chondri (marked by arrows) standing in relief above the general surface. Magnification: x $^3/_2$.

Fig. 2. The appearance of a microscope slide of the Karoonda meteorite viewed by transmitted light and magnified 15 diameters. Several chondri, composed of a coarser granular material, are to be observed set in a fine brecciated base of olivine, enstatite, troilite, etc.

NOTES ON FOSSILIFEROUS CAMBRIAN NEAR KULPARA, SOUTH AUSTRALIA.

By T. A. Barnes, B.Sc., and A. W. Kleeman, B.Sc.

[Read November 9, 1933.]

The area under consideration in this paper is on the main Port Wakefield-Wallaroo road, about two miles east of Kulpara. The existence of Cambrian limestone in this area was reported by Professor Howchin in 1925.[1] Professor Howchin noted fragmentary trilobites in the limestones of this area. The present investigations were undertaken at the suggestion of Mr. A. K. M. Edwards, B.Sc., who had also noted trilobites in this vicinity. We are indebted to him for much help in our work in this area.

Physiographically the area is on the eastern fault scarp of the Yorke Peninsula Horst. Here the easterly flowing streams have cut into the deep soil of the old peneplain and have exposed the beds. The more rapid erosion has also stripped the cover of soil from the hillsides, and so outcrops are common.

The observed succession of beds is:—

(d) Shales with thin interbedded limestones. Both shales and limestones contain fossils.

(c) Massive limestones unfossiliferous, 900 feet thick.

(b) Thick series of red and white flaggy quartzites of a variable nature, 900 feet thick.

(a) Purple slates.

The fault scarp strikes N. 20° E., and the beds where they were examined on the edge of the peneplain on the west side of the fault strike N. 10° E. and have a general easterly dip. Thus the upper limit of the shales, in the area examined, is cut off by the fault. The lower limit of the quartzite is obscured by the deep soils of the old peneplain, with the exception of the southern end of the area, where a stream has cut into the beds exposing purple slates.

The massive limestone, which forms the strongest bed of the area, outcrops well in creek beds and on hill slopes, and can be traced both north and south from the main road. The western limit of the limestone, which crosses the road at junction of Sections 230 and 229 (Hd. of Kulpara), can be traced southward into Section 498, where it appears to be cut off by the fault. The eastern limit is lost in Section 206. The dip is fairly constant 25° to the east. The limestone is massive, blue to white in colour, and dolomitic. It is unfossiliferous except for some doubtful worm burrows.

The shales which overlie the massive limestone do not give good exposures, but occasional interbedded thin limestones shed boulders on hill slopes and outcrop in creeks. Trilobite remains are found in these thin limestones. There is a pipe track running in direction N. 56° E through Sections 230 and 231, which cuts both the shales and the massive limestones. It was amongst the shale fragments thrown up in the laying of this pipe track that the best fossils were found. It is probable that these shales have a well-preserved trilobite fauna at depth, but it was found impossible to get unweathered material.

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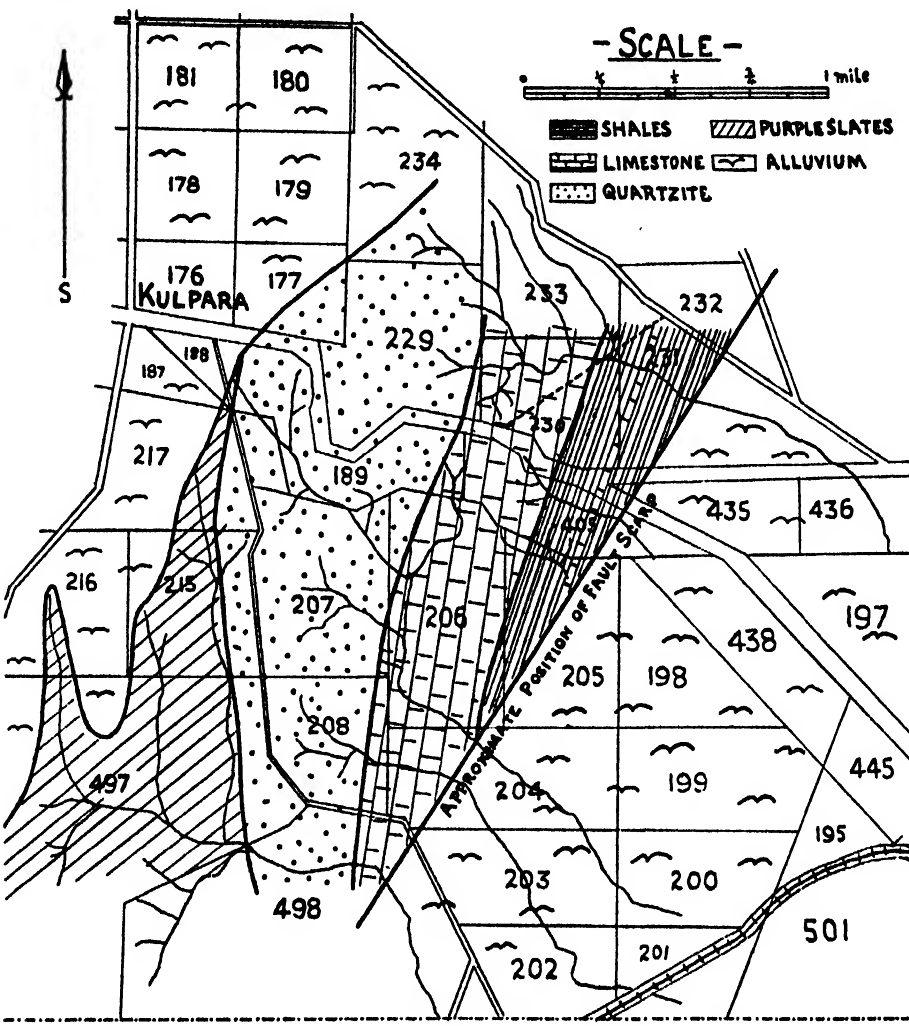
(1) Howchin, W., The Geographical Distribution of Fossiliferous Rocks of Cambrian Age in South Australia, with Geological Notes and References, Trans. Roy. Soc. S. Austr., vol. xlix., pp.1-26, 1925.

The quartzites which underlie the limestones are variable in nature, being in the main red and white flaggy quartzites. As one passes westward along the road the dip becomes less, until in Section 189 the dip is 10° to the east. In Section 498, in the southern portion of the area, a creek running west to east gives a good section exposing the quartzites resting conformably on purple slates. The quartzites are about 900 feet thick.



LOCALITY PLAN.

The purple slates underlie the quartzites in Section 498, dipping at 20° to the east. They extend westerly into Section 497, where they become contorted with the formation of asymmetric folds. There was no unconformity observed between the slates and the overlying quartzites.

These slates are the oldest beds observed, and time did not permit us to follow the sequence westward or southward.

A feature of the area is the formation of limonite at the junction of the quartzites and the limestones. The quartzite immediately below the limestone is much ferruginised.

The trilobite remains found were submitted to Mr. F. Chapman, F.L.S., etc., Commonwealth Palaeontologist, who kindly supplied the following note:—"They seem to represent a Middle Cambrian facies and are all referable to two species of the genus *Ptychoparia*. The species with the smaller cephalon bears a close resemblance to Woodward's *Dolichometopus tatei*, but as the original type specimen is very imperfect there is a doubt about it and it may be a new species. The other species is related to *Ptychoparia howchini*, but as the apex of the glabella in your specimen is much more pointed, this also is probably new."

Careful search was made for Archaeocyathinae, but none could be found. It is probable that the Archaeocyathinae did not relish the muddy and sandy conditions indicated by the associated beds.

The fossiliferous shales thus studied are, on the above evidence, probably of Middle Cambrian Age. They are underlain by 900 feet of limestone and 900 feet of quartzites. The quartzites might prove to be fossiliferous if carefully searched. The quartzites pass down into purple slates of unknown age. Detailed work would be necessary to clear up the relation of these beds to the Adelaide Series.

THE COMPOSITION OF SOME IRONSTONE GRAVELS FROM AUSTRALIAN SOILS.

By J. A. Prescott, Waite Institute, Glen Osmond.

[Read April 12, 1934.]

A feature of many soils associated with uplifted peneplains in Australia is the presence of ironstone gravels, which in most cases are attributed [Prescott, Ref. 5] to former periods of wetter soil conditions when water-logging and shallow water tables were more common than is at present the case. These gravels are usually concretionary in character, and are further frequently found in association with ironstone "duricrusts" or laterite cappings. A number of gravels separated from soil samples collected in Western Australia and South Australia have been examined with a view to determining their general character and the amount of free iron and aluminium oxides present.

Of the methods available for the examination, three appeared to present useful possibilities—one, the extraction with boiling hydrochloric acid as employed in soil analysis; the second, the extraction with a mixture of the three strong acids as recently standardised by Groves (Ref. 2); and the third, the extraction with boiling oxalic acid which was known to dissolve iron oxide from soils, but the action of which on the other constituents of the ironstone gravels was unknown. In addition, there was the possibility of employing the method of alizarin adsorption as used by Hardy (Ref. 3), in order to detect free alumina, if this were present.

As free iron oxide is one of the important mobile components of the soil profile, some method for its separate estimation would be of value, but it is evident that the most promising method, that of extraction with oxalic acid, accounts for more than the free oxide, and has some decomposing action on the clay of the soil.

The concretionary character of the gravels implies that they will contain material from the soil in which they have been developed, and that this is indeed the case is indicated from an inspection of the data in Tables I. and II.

The samples examined were selected from materials collected during the course of exploration and survey, and forming part of the Waite Institute soil collection. Their origin is given below:—

No. 2,306. Collected by Mr. Michael Terry from Gibson's Desert, 178 miles from Hazlett's well in the Warburton Ranges on the way to Laverton. The sample represents the material larger than 2 mm. separated from soil samples taken from the surface to a depth of 26 inches from a gravelly undulation.

No. 2,310. Collected by Mr. Michael Terry from Gibson's Desert, 80 miles from Hazlett's well. The sample represents the material larger than 2 mm. separated from soil samples to a depth of 27 inches from a gravelly flat.

No. 2,296. Collected by Mr. Michael Terry from Gibson's Desert, 79 miles from Hazlett's well. The gravel is separated from a soil sample six inches in depth.

No. 2,954. Collected by Mr. Michael Terry from the vicinity of the Warburton Ranges. The gravel is separated from soil samples to a depth of 28 inches. 20% of the original gravel consisted of quartz.

——— Single hollow concretion collected from the surface of the sand plain near Mingenew, W. Aust., by the author.

——— Ironstone capping from the flat summit of King's Table Hill, north-east of Geraldton, W. Aust., collected by the author.

——— Capping from the summit of a "rise" near Goomalling, W. Aust., collected by the author.

No. 3,068. Collected by Mr. J. S. Hosking at Gingin, W. Aust., from soil horizons down to 24 inches.

No. 3,021. Collected by Mr. J. S. Hosking at Gingin from red-brown sands associated with the upper and lower greensands. Gravel is separated from soil horizons down to 80 inches. Original contained 55% of quartz gravel.

No. 2,995. Collected by Mr. J. S. Hosking at Walpole, W. Aust., in typical karri and tingle country, from soil horizons down to 48 inches. Original contained 10% of quartz gravel.

No. 2,694. Collected by Dr. E. J. Underwood at Denmark, W. Aust., in karri country, from the top 22 inches of soil. Original contained 53% of quartz.

——— Single pieces of ironstone collected from the surface of the soil by the author at Alawoona, S. Aust.

No. 2,962. Ironstone gravel collected from the surface of the soil by the author in sandy scrub country at Waitpinga, S. Aust.

No. 1,850. Collected by the author; gravel separated from the top 27 inches of soil in the Hundred of Kuitpo, Section 279. 51% of the original gravel consisted of non-ironstone material, mainly mica-schist.

No. 1,961. Collected by Mr. R. J. Best at Birdwood, S. Aust. Gravel separated from soil horizon 9 to 14 inches, and of which 32% consisted of quartz.

No. 2,481. Collected by Mr. J. S. Hosking at Hawk's Nest, Kangaroo Island. Gravel separated from surface 13 inches of soil. 3% consisted of quartz and sandstone.

No. 2,485. Collected by Mr. J. S. Hosking at Hawk's Nest, Kangaroo Island. Gravel separated from surface 18 inches of soil. 3% consisted of quartz and sandstone.

The gravels were hand-picked to remove quartz or other material not typically ironstone in character, and then washed thoroughly by shaking with dilute ammonia to remove any adhering clay. After thorough washing with cold water the gravels were air-dried and ground to pass an 0·5 mm. sieve. For the alizarin adsorption test this material was further sub-sampled and ground to pass a 90-mesh sieve.

For the extraction with hydrochloric acid, digestion in the water bath for 48 hours, as employed in soil analysis, was adopted. In two cases only extraction with the tri-acid mixture and 5% oxalic acid was attempted. As the oxalic acid

extraction was not specific enough, it was not adopted for the remainder of the samples. A comparison of the results obtained by the three methods is given in Table I.

TABLE I.

	Insoluble ignited %	Fe_2O_3 %	Al_2O_3 %	TiO_2 %	SiO_2 %	Moisture %	Loss on ignition %	Total %
Goomalling:								
Tri-acid extraction	0·0*	21·8	25·8	1·2	39·0	1·6	10·6	100·0
HCl extraction	42·1	22·1	23·5	0·5	—	1·6	10·6	100·4
Oxalic acid extraction	51·2	20·9	7·0	—	—	1·6	10·6	91·3
Denmark (2694):								
Tri-acid extraction	4·4*	52·1	12·9	0·8	22·2	2·8	5·3	100·5
HCl extraction	26·8	51·8	12·7	0·5	—	2·8	5·3	99·9
Oxalic acid extraction	32·1	47·8	9·0	—	—	2·8	5·3	97·0

* After treatment with HF.

The oxalic acid extraction was carried out by digestion on the water bath overnight. The residue was greyish-white in colour, all free iron oxide having presumably been extracted. The oxalic acid extract was observed to contain silica.

The adsorption by alizarin followed the technique of Hardy, one gramme of the finely divided material being treated first with an 0·5% solution of alizarin–S in 80% alcohol saturated with boracic acid, and after careful washing extracted with saturated sodium oxalate-oxalic acid solution (8·8 gm. oxalic acid + 16·2 gm. sodium oxalate per litre). There is no great regularity in the results, the weighted mean of the adsorption values for the fresh material corresponding to 4·94 mgm. of alizarin–S per gramme of Fe_2O_3, Hardy and Follett-Smith's value for limonite being 1·28 mgm. per gm. The adsorption of the ignited material was expected to throw some light on the presence or absence of free alumina in these ironstones. Hardy's figures for the adsorption of alizarin by ignited Gibbsite correspond to 23·6 mgm. per gm. of Al_2O_3, which would suggest that free alumina may actually be present to the extent of 1% or 2% in most of the samples.

The results of the analyses of the hydrochloric acid extracts and of the alizarin adsorption tests are given in Table II. The quantities of Fe_2O_3 extracted vary from 22 % to 74%. Probably the most interesting feature is the very low amount of manganese present in these gravels. This is in marked contrast to conditions in the red loams of Queensland, where it has been shown by Best (Ref. 1) that concretions may contain up to 10% of Mn.

REFERENCES.

1. BEST, R. J. "J. Agric. Sci.," **vol. xxi., p. 337.** 1931.
2. GROVES, RUBY C. "J. Agric. Sci.," **vol. xxiii., p.** 519. 1933.
3. HARDY, F. "J. Agric. Sci.," **vol. xxi., p.** 150. 1931.
4. HARDY, F., and FOLLETT-SMITH, R. R. "J. Agric. Sci.," **vol. xxi., p.** 739. 1931.
5. PRESCOTT, J. A. "Coun. Sci. Ind. Res." Bull. lii. 1931.

TABLE

Sample Number	Locality	Depth in Inches.	Moisture	Loss on Ignition	Extracted by Digestion with Hydrochloric Acid: Ignited Residue	Fe$_2$O$_3$	Al$_2$O$_3$	TiO$_2$	Mn$_3$O$_4$	Total	Alizarin Adsorption mgm. per gm.: Fresh	Ignited	Fresh per gm. Fe$_2$O$_3$
			%	%	%	%	%	%	%	%			
	WESTERN AUSTRALIA:												
2306	Gibson's Desert	0–26	0·7	8·7	52·6	30·8	6·8	0·2	0·00	99·8	2·17	0·37	7·02
2310	Gibson's Desert	0–27	0·8	6·0	38·5	49·0	5·5	0·3	0·07	100·2	2·61	0·72	5·32
2296	Gibson's Desert	0–6	0·9	10·0	40·3	42·8	5·6	0·3	0·01	99·9	1·69	1·13	3·96
2954	Warburton Range	0–28	1·2	4·6	23·7	66·0	4·1	0·8	0·03	100·4	4·09	0·38	6·20
—	Mingenew	surface	0·9	3·1	54·3	39·8	2·8	0·3	0·01	101·2	0·00	0·27	0·00
—	King's Table Hill	capping	0·7	3·7	19·5	74·3	3·6	0·0	0·05	101·8	2·72	0·00	3·66
—	Goomalling	capping	1·6	10·6	42·1	22·1	23·5	0·5	0·01	100·4	3·77	2·67	17·10
3068	Gingin	0–24	2·0	7·6	42·6	37·8	9·9	0·2	0·00	100·1	2·51	1·48	6·63
3021	Gingin	0–80	1·5	4·7	29·0	54·0	9·5	0·2	0·00	98·7	5·03	1·28	9·32
2995	Walpole	0–48	2·8	8·9	29·9	42·8	14·9	0·2	0·00	99·5	3·46	1·74	8·08
2694	Denmark	0–22	2·8	5·3	26·8	51·8	12·7	0·5	0·02	99·9	3·24	0·28	6·27
	SOUTH AUSTRALIA:												
—	Alawoona	surface	0·4	6·6	54·5	34·7	2·0	0·1	0·00	100·2*	0·58	3·38	1·67
2962	Waitpinga	surface	0·6	1·7	47·7	44·9	4·3	0·4	0·02	99·6	0·86	0·25	1·91
1850	Kuitpo	0–27	1·7	3·4	32·7	54·0	8·1	0·2	0·00	100·1	1·79	0·82	3·32
1961	Birdwood	9–14	0·7	2·6	29·4	57·6	8·6	0·4	0·01	99·3	1·32	0·73	2·29
2481	Kangaroo Island	0–13	1·2	1·7	49·8	41·0	6·7	0·3	0·01	100·7	1·17	0·36	2·86
2485	Kangaroo Island	0–18	1·3	2·1	37·3	50·0	9·2	0·3	0·02	100·2	2·35	0·75	4·70
												Weighted Mean	4·94

MgO. Ma ial washed h 2NHC1 prior to a ad

KINSHIP AND DESCENT AMONG THE AUSTRALIAN ABORIGINES.

By H. K. Fry, D.S.O., M.B., B.S., B.Sc., D.P.H., Dipl.Anth.

[Read April 12, 1934.]

A line drawn from the Albert River in the Gulf of Carpentaria to Fowler's Bay on the Great Australian Bight approximately represents the former division of Australia into an eastern matrilineal and a western patrilineal area.

The eastern and western peoples, however, were not homogeneous in regard to descent. Patrilineal societies existed at the Murray Mouth, in the Melbourne district, on the coast of New South Wales and the adjacent portion of Victoria, and in Queensland near Maryborough and in a part of Cape York Peninsula.

Matrilineal societies existed in the western area in the district about Perth, and still exist in the Coburg Peninsula and in Melville and Bathurst Island. W. E. H. Stanner (Ref. 22, pp. 398-400) has described the Nangiomeri tribe of the Daly River as a patrilineal people in the process of transition to a matrilineal class and totem system. The new regime is considered to have spread from the Eastern Kimberley or Hall's Creek district. The social system which has resulted is similar to that of Eastern Arnhem Land (Ref. 23, pp. 416, 417), so that the latter society also may be interpreted as a mingling of patrilineal and matrilineal institutions. The tribes of the Victoria River have patrilineal classes but matrilineal totems. All the tribes of north-western Western Australia and the northern part of the Northern Territory have patrilineal class systems, but these are also matrilineal in that the children of irregular marriages take the class determined by that of the mother, not the father. Children of irregular marriages in Central Australia follow the father.

Therefore it would appear that an increasingly marked matrilineal influence is manifested in this western area as the coast is approached.

The eastern area presents the converse condition. But the patrilineal societies of the coastal regions of the eastern area, and also of the southern zone near the coast of the western area, are of a different type to the societies which make up the great part of the western patrilineal area. The former are organised in local groups or moieties named, like the matrilineal classes, after animals. The classes of the latter societies have names which suggest an origin from kinship terms. An illustration of the manner in which such terms could become class names is given by Howitt (Ref. 15, p. 230). Also the initiatory rites of the former societies usually conform to those typical of the matrilineal area.

The Kinship Systems of Paternal and Maternal Societies.

The usual pattern of social organisation of both patrilineal and matrilineal societies in Australia can be represented (Ref. 10, p. 16; Ref. 11, pp. 29, 34; Ref. 12, p. 271) [1] diagrammatically as shown in Table I.:—

[1] I have found that unilateral cross-cousin marriage can be expressed by a system of three clans, a1, b1, and c1. The type marriages and kinship patterns in this case are homologous with those given (Ref. 11, p. 30) for four or more clans. These patterns represent the intermarriage of six kinship groups or classes. They permit the marriage of second cousins, but as they also allow marriage with father's sister's daughter or mother's brother's daughter, six kinship groups do not express partially the Aranda norm as stated (Ref. 12, p. 271). The conclusion that at least eight marriage divisions are necessary for the expression of the Aranda norm of kinship marriage rule, therefore, is more definite than was stated previously.

TABLE I.

1.	a1	A1	b1	B1	a2	A2	b2	B2
2.	a1	B1	b1	A1	a2	B2	b2	A2
1.	a1	A2	b1	B2	a2	A1	b2	B1
2.	a1	B2	b1	A2	a2	B1	b2	A1
1.	a1	A1	b1	B1	a2	A2	b2	B2

The table represents the genealogical relationships of eight marriage divisions (classes or kinship groups). Each horizontal line represents a generation. The numbers at the beginning of each line apply to all the terms of that line, so that the eight marriage divisions are expressed by the eight terms, 1a1, 1b1, 1a2, 1b2, 2a1, 2b1, 2a2, and 2b2. Corresponding terms in small case letters and capitals, such as 1a1 and 1A1, represent individuals of opposite sexes who are members of one division. Members of "a" divisions and "b" divisions intermarry. The vertical columns of the table represent lines of male and female descent, so that "son" in one line is directly under "father" in the line above, and "daughter" under "mother." For example, 2a1 and 2A1 are the children of 1a1 and 1B1; 2b1 and 2B1 are the children of 1b1 and 1A1; 1a1 and 1A1 are the children of 2a1 and 2b2. The children take the denomination of the father in a patrilineal society, so the terms in small case letters represent males and those in capitals represent females when the table is used to illustrate a patrilineal system. Conversely the letters in small case represent females and the terms in capitals represent males when the diagram is applied to the conditions of a matrilineal society.

Table I. can be used as a chart upon which relationship terms can be plotted.

The kinship terms used by an Australian native and his sister are identical in regard to individuals who have the status of actual kindred. For example, a man and his sister usually use the same terms for individuals who have the status of parents or relatives of parents. Similarly, a man's sons and daughters and their children are referred to by the man's sister in the same terms that he uses, and a woman's sons and daughters and their children are designated by her brother by the same terms which she uses. But individuals of the same or of the two contiguous generations who have the status of affinities, *i.e.*, relatives by marriage, usually are addressed by different terms by a man and his sister, so that the pattern of kinship terminology is not quite the same when *Ego* is represented alternatively by a man and his sister.

The pattern of Table I. obviously is not symmetrical in regard to male and female representatives of marriage divisions, one vertical column representing a cycle of two generations, the other a cycle of four generations. Therefore the pattern which appears when the kinship terminology of a matrilineal society is plotted upon Table I., will be different from the pattern which illustrates the terminology of a patrilineal organisation.

Four different patterns of genealogical relationships can be plotted on the table, therefore, corresponding to the varying circumstances that *Ego* may be a male or a female, and that descent may be matrilineal or patrilineal.

These four patterns are illustrated in Table II.

The form of Table II. is that of Table I. Under each of the symbols representing the marriage divisions the four variations of genealogical relationship are indicated. *Ego* is represented alternatively by the brother and sister symbols 1a1 and 1A1 in the third generation. Genealogical relationships are charted under each of the symbols corresponding to those of Table I. in the following order:—

(i.) Relationships where *Ego* is 1a1, a male, in a patrilineal system.
(ii.) Relationships where *Ego* is 1A1, a female, in a patrilineal system.
(iii.) Relationships where *Ego* is 1A1, a male, in a matrilineal system.
(iv.) Relationships where *Ego* is 1a1, a female, in a matrilineal system.

It will be seen that the relationships of line (i.) are the exact converse in sex terms to those of line (iv.), and the relationships of line (iii.) the converse of those of line (ii.).

Native kinship terms usually are not so numerous as the genealogical relationships of Table II., as the same term is often applied to members of the same marriage division which reappears in alternate generations.

In the following discussion male-speaking kinship terms only will be considered, and the comparison of the matrilineal and patrilineal patterns will be confined to the relationships represented in lines (i.) and (iii.).

Cross-cousins in both matrilineal and patrilineal systems will be seen to be associated with the kinship divisions 1b2 and 1B2 in Table II. But the same kinship divisions, 1b2 and 1B2, in the second ascending generation are associated with the relationships of mother's father and his sister in a patrilineal system, and with the relationships of father's mother and her brother in a matrilineal system.

Similarly the same kinship divisions, 1b2 and 1B2, in the second descending generation are associated with the relationships of daughter's son and daughter in a patrilineal system, but with the relationships of sister's son's daughter and son in a matrilineal system.

Both mother's mother's brother and his son's son in a patrilineal system will be seen to be associated with the kinship group 1a2 in Table II. On the other hand, in a matrilineal system, mother's mother's brother is 1A1 and his son's son is 1A2, so these individuals respectively belong to different divisions.

Professor Elkin, in discussing the matrilineal Dieri system (Ref. 6, pp. 495-6), has pointed out that the Dieri use one term for cross-cousin and father's mother, but that many tribes of the Aranda type use one term for cross-cousin and for wife of mother's mother's brother [mother's father's sister in Table II., line (i.)]; also that the Aranda use one term for mother's mother's brother and his son's son, but that the Dieri do not.

The Aranda is a patrilineal system, and it is evident that these contrasting features of kinship terminology are the direct and natural outcome of the contrasting relationship patterns of matrilineal and patrilineal societies.

Reference to Table II. will show that in a patrilineal system 1B1, wife, corresponds in the second descending generation with 1B1, sister's son's daughter. Marriage with the latter woman is a well-recognised rule in the patrilineal area of North-Western Australia. (Ref. 8, p. 308). I have been able to find only one instance in published works where the same term is applied to wife and sister's son's daughter (Ref. 1, p. 182), but many should appear when full terminologies of the north-western tribes are published. Another example has been discovered personally in the Pintubi tribe in Central Australia. The general possibility of this form of marriage in patrilineal societies is indicated by the fact that in patrilineal tribes it is the rule to use one term for both wife's mother and sister's son's wife (2A2, in Table II).

On the other hand, in a matrilineal society, the pattern of Table II. demonstrates that 1b1, wife, corresponds in the second descending generation with 1b1, daughter's daughter, while sister's son's daughter is 1b2. The Dieri term for the two former relationships is *nadada*, that for the last is *kami*. Howitt (Ref. 15, p. 164) has described marriage with the brother's daughter's daughter in the matrilineal Dieri people. Dr. Elkin has challenged this observation (Ref. 6, p. 196), but his argument is not convincing. The general possibility of this form of marriage in matrilineal societies is indicated by the use in matrilineal tribes of one term for both wife's father and daughter's husband (2A2, in Table II.), *e.g.*, Dieri *taru* (Ref. 15, p. 160; Ref. 6, p. 197); Chaap wuurong *niitchang*

Table II.

				a1	A1	b1	B1	a2	A2	b2	B2
	1.										
	♂. Patl.		(i.)	f.f.	f.f.s.	f.m.b.	f.m.	m.m.b.	m.m.	m.f.	m.f.s.
	♀. ,,		(ii.)	f.f.	f.f.s.	f.m.b.	f.m.	m.m.b.	m.m.	m.f.	m.f.s.
	♂. Matl.		(iii.)	m.m.	m.m.b.	m.f.s.	m.f.	f.f.s.	f.f.	f.m.	f.m.b.
	♀. ,,		(iv.)	m.m.	m.m.b.	m.f.s.	m.f.	f.f.s.	f.f.	f.m.	f.m.b.
	2.			**a1**	**B1**	**b1**	**A1**	**a2**	**B2**	**b2**	**A2**
	♂. Patl.		(i.)	f.	w.f.s.	w.f.	f.s.	w.m.b.	m.	m.b.	w.m.
	♀. ,,		(ii.)	f.	h.f.s.	h.f.	f.s.	h.m.b.	m.	m.b.	h.m.
	♂. Matl.		(iii.)	m.	w.m.b.	w.m.	m.b.	w.f.s.	f.	f.s.	w.f.
	♀. ,,		(iv.)	m.	h.m.b.	h.m.	m.b.	h.f.s.	f.	f.s.	h.f.
	1.			**a1**	**A2**	**b1**	**B2**	**a2**	**A1**	**b2**	**B1**
Ego a1	♂. Patl.		(i.)	b.	f.f.s.d.d.	w.b./s.h.	f.s.d./m.b.d.	m.m.b.*s.s.*	s.	m.b.*s.*/f.s.*s.*	w.
Ego A1	♀. ,,		(ii.)	b.	f.f.s.d.d.	h.	f.s.d./m.b.d.	m.m.b.*s.s.*	s.	m.b.*s.*/f.s.*s.*	h.*s.*/b.w.
Ego A1	♂. Matl.		(iii.)	s.	m.m.b.*s.s.*	w.	m.b.*s.*/f.s.*s.*	f.f.s d.d.	b.	f.s.d./m.b.d.	w.b./s.h.
Ego a1	♀. ,,		(iv.)	s.	m.m.b.*s.s.*	h.*s.*/b.w.	m.b.*s.*/f.s.*s.*	f.f.s.d.d.	b.	f.s.d./m.b.d.	h.
	2.			**a1**	**B2**	**b1**	**A2**	**a2**	**B1**	**b2**	**A1**
	♂. Patl.		(i.)	*s.*	*s.*w.	s.*s.*	s.*s.*w.	s.d.h.	s.d.	d.h.	d.
	♀. ,,		(ii.)	b.*s.*	b.*s.*w.	*s.*	*s.*w.	d.h.	d.	b.d.h.	b.d.
	♂. Matl.		(iii.)	s.d.	s.d.h.	d.	d.h.	*s.*w.	*s.*	s.*s.*w.	s.*s.*
	♀. ,,		(iv.)	d.	d.h.	b.d.	b.d.h.	b.*s.*w.	b.*s.*	*s.*w.	*s.*
	1.			**a1**	**A1**	**b1**	**B1**	**a2**	**A2**	**b2**	**B2**
	♂. Patl.		(i.)	*s.s.*	*s.*d.	s.*s.s.*	s.*s.*d.	s.d.*s.*	s.d.d.	d.*s.*	d.d.
	♀. ,,		(ii)	b.*s.s.*	b.*s.*d.	*s.s.*	*s.*d.	d.*s.*	d.d.	b.d.*s.*	b.d.d.
	♂. Matl.		(iii.)	s.d.d.	s.d.*s.*	d.d.	d.*s.*	*s.*d.	*s.s.*	s.*s.*d.	s.*s.s.*
	♀. ,,		(iv.)	d.d.	d.*s.*	b.d.d.	b.d.*s.*	b.*s.*d.	b.*s.s.*	*s.*d.	*s.s.*

Explanation . f. = father m. = mother b. = brother s. = sister *s.* = son d. = daughter h. = husband w. = wife

niitch; Kuurn kopan *naluungar* (Ref. 5, pp. lxvi., lxvii., lxxiii., lxxiv.); Maroura *yundawa* (Ref. 25, p. 167).

Professor Rivers has brought out the evidence for marriage with the daughter's daughter or grandmother in Melanesia. He has deduced mechanisms by which such marriages could have originated. Sir George Grey (Ref. 13, vol. ii., p. 230) and W. A. Cawthorne (Ref 4, p. 76), speaking of the Perth and Adelaide tribes respectively, have stated that old men exchanged their daughters in marriage. This would mean that each man would marry his daughter's husband's daughter, that is, his classificatory daughter's daughter.

Daughter's husband in Australian patrilineal tribes is designated normally by the same term as is mother's brother. These relations are associated in each case with the kinship division 2b2 in Table II., line (i.).

Sister's son's wife in the matrilineal pattern corresponds to father's sister [both 2b2 in Table II. line (iii.)], and both may be termed *papa* in the Dieri tribe (Ref. 6, p. 496).

Therefore the evidence derived from genealogical relationship pattern, kinship terminology, and observed marriage customs, is in favour of the generalization that the normal marriage in Australia with a woman of the second descending generation is with a sister's son's daughter in patrilineal societies, and with the classificatory daughter's daughter in matrilineal societies.

Professor Radcliffe Brown (Ref. 1, p. 192) attempted to differentiate a variety (a) of Type II system by virtue of the distinction that in these tribes marriage with a relative corresponding to sister's son's daughter was permitted. This form of marriage is permissible in some tribes classified as Type I., so the original distinction has not been confirmed. It has been shown, however, in the last paragraph, that the contrasting kinship systems of matrilineal and patrilineal societies exhibit the differentiation which was suggested.

These differences of kinship terminology are not reflected in the method of disposal of a woman in marriage in matrilineal and patrilineal societies in Australia.

The father, usually associated with the nearest male relative, is described as disposing of his daughter in matrilineal tribes by Grey and Cawthorne, *loc cit.:* Taplin, Ref. 26, p. 10; Meyer, *ibid,* p. 190; Schuermann, *ibid,* p. 222; Taplin *et alii,* Ref. 25, pp. 30, 35, 50; Brough Smyth, Ref. 18, p. 77; Fraser, Ref. 9, p. 27; and by Howitt, Ref. 15, pp. 185, 193, 198, 205, 210, 227, 241, 245, 251, 267; and in patrilineal tribes by Spencer and Gillen: Ref. 19, p. 558; Ref. 20, p. 77; by Howitt, Ref. 15, pp. 232, 236, 254, 255, 257, 260, 263; Strehlow, Ref. 24, p. 89; and Radcliffe Brown, Ref. 1, p. 156.

The mother or mother's brother is stated to be the person responsible in matrilineal societies by Howitt (Ref. 15, pp. 177, 178, 195, 217, 222) and Roth (Ref. 17, p. 181); in patrilineal societies by Spencer and Gillen (Ref. 20, p. 603, *cf.*, pp. 77, 114); Radcliffe Brown (Ref. 1, p. 185; Ref. 3, p. 336); and Elkin (Ref. 8, p. 309). Howitt also states that the mother's brother punishes an erring sister's daughter (Ref. 15, p. 232). Spencer (Ref. 21, p. 51) states that in the Kakadu tribe the father arranges a normal marriage and the mother's brother the marriage with the step son.

Is there a Kinship System Intermediate between those of Matrilineal and Patrilineal Societies.

The kinship terminology of both matrilineal and patrilineal Australian tribes represents bilateral descent in that a husband and his wife, in common with their respective brothers and sisters, apply different kinship terms to members of the descending generations.

But matrilineal and patrilineal tribes each have their distinctive pattern of kinship terminology, as has been demonstrated. Should such tribes merge on

an equal footing, reference to Table II. will show that a conformable kinship terminology could result only by a merging of kinship terminology which may be represented diagrammatically by superimposing the two lateral halves of Table II. This manoeuvre would convert the eight-class form of the diagram into the form of a four-class diagram (*cf.* Fry, Ref. 10, pp. 16, 17), which would be conformable to a simpler kinship terminology in which first cousins would not be distinguished from second cousins.

No tribal system has been described which conforms completely in kinship terminology to this ideal four-class system. The Urabunna and Kariera are partial representatives. It is noteworthy that the former tribe lies on the matrilineal side of the borderline between the matrilineal and patrilineal areas. The Kariera is far within the patrilineal zone, but is situated peripherally on the coast where there are traces of matrilineal survivals, as has been discussed in the introduction to this paper.

A plausible explanation of the appearance of such systems is that they represent a compromise between the social organisation of matrilineal and patrilineal tribes. An alternative explanation has been proposed by A. W. Howitt and Professor Radcliffe Brown.

Howitt (Ref. 15, p. 189) advanced the idea that the Urabunna system represented a marriage rule permitting marriage with the father's sister's or mother's brother's daughter, and contrasted this with the marriage rule of the Dieri prescribing marriage with the mother's mother's brother's daughter's daughter, or mother's father's sister's daughter's daughter. Both of these tribes are matrilineal. Howitt considered that the Dieri rule is a development of that of the Urabunna, although he had suggested immediately before that the Urabunna rule in regard to totems was later than that of the Dieri. Radcliffe Brown formulated similar views in regard to Australian marriage rules, but found the Urabunna system unsatisfactory. He claimed to have found a more satisfactory example in the patrilineal Kariera tribe. The Kariera system, as Type I., was contrasted with the patrilineal Aranda system, which was termed Type II. (Ref. 1, pp. 190, *et. seq.*). The term "norm" has been substituted for that of Type (Ref. 3, p. 46, footnote). Professor Radcliffe Brown considers that the Aranda norm of kinship system is not derived historically from the Kariera norm, but that the Kariera and Aranda systems are two terms in an evolutionary process (Ref. 3, p. 452).

With regard to these type tribes, Dr. Elkin has confirmed Professor Radcliffe Brown's objection to the Urabunna, as he has found that the kinship system of this tribe approximates to that of the Dieri, and that the marriage rule is that of marriage with a distant second cousin (Ref. 3, pp. 56, 57). This author also states that the neighbouring Parnkala and Wailpi tribes are of the Kariera type, but does not give any detailed terminology. But the Kariera tribe is not as complete an example of the ideal type as Professor Radcliffe Brown has supposed. He has given only two male-speaking relationship terms for members of the second descending generation, namely, *maeli* and *tami*, for children of son and daughter respectively. He has given, however, the two female-speaking terms, *kabali* and *kandari* (Ref. 1, p. 153), for the children of a woman's son and daughter, respectively. This means that the Kariera terminology conforms exactly to that of the Aranda system in so far as the second descending generation is concerned.

Professor Elkin has published kinship terms of the patrilineal tribes of the Kimberley area to the north of the Kariera (Ref. 8, p. 296). The kinship terminologies of all these tribes, except the Ungarinyin, approximate to that of an ideal four-class system, but none is a complete example. The same applies to the

kinship terms given by Spencer (Ref. 21, p. 65, *et. seq.)* for the tribes of the Darwin area.

The Mungarai and Nullakun tribes of the Roper River have a predominantly patrilineal terminology, but use one term for wife's father and daughter's husband (Ref. 21 pp. 76, 78). Adequate information regarding the kinship systems of the tribes of the eastern matrilineal area of Australia is woefully lacking. But two examples of mixed terminology have been found.

The Yaralde was a tribe organised in patrilineal totemic clans. Marriages were carried out regularly with women of the surrounding tribes with matrilineal class systems. The terminology of the Yaralde (Ref. 2, pp. 232-237) is predominantly patrilineal, but one term, *yulundi,* was applied to wife's father and daughter's husband. The patrilineal Kurnai tribe also used one term, *ngaribil,* for these two relations by marriage (Ref. 14, p. 237; Ref. 15, p. 169).

All the examples given above occur in areas where matrilineal and patrilineal systems have, or may have, come in contact, and therefore these examples support the hypothesis that these kinship systems represent different degrees of compromise between matrilineal and patrilineal systems.

Evidence against this interpretation of the origin of such systems is that coastal tribes such as the Mara and Anula have a kinship system which is apparently entirely patrilineal (Ref. 20, pp. 87, 88); the same is true of the Waduman tribe with patrilineal classes and matrilineal totems (Ref. 21, p. 81). Conversely the Melville Island tribe, although apparently isolated, has a kinship system which approximates to the four-class type (Ref. 21, p. 71).

On the other hand, the outstanding objection to the alternative interpretation that the simpler kinship systems are the result of a marriage rule allowing marriage with first cousins is that this rule is not a valid one in fact. Marriage with an actual first cousin is exceptional in tribes of the "Kariera" type, and marriage with a distant cross-cousin is usual. Obviously a distant cross-cousin is at least a second cousin, which is the typical marriage-relation under the "Aranda" rule. Also, in tribes of the "Aranda" type, marriage with a first cousin is permitted under exceptional circumstances. Professor Radcliffe Brown has recognised this lack of differentiation between the two systems which he formerly termed types, as he states that "in spite of the diversity of the various systems, a careful comparison reveals them as being variations of a single type" (Ref. 3, p. 455).

Howitt and Radcliffe Brown have differentiated the apparently simpler organisations of the Urabunna and Kariera tribes from the Dieri and Aranda systems in order to present the former as more primitive evolutionary types than the latter. This opinion is questionable, as it is quite probable that the Aranda and Dieri systems are "primitive." The usual marriage rule in kinship terms throughout Australia is the prohibition of marriage between kindred nearer than cross-cousins who are distant in regard to consanguinity and locality. Family groups in Australia have territorial limits. Marriage with a distant kin not only minimises the danger of infringing the *tabu* on parents-in-law, but also gives a certain right of entry to other districts in addition to that of the mother. These considerations could operate from the very early times of the occupation of Australia, and the emphasis on "distant" cross-cousin marriage could be as primitive as the recognition of proprietary rights over a certain district by a family group. Such emphasis would entail the distinction from early times of wife's mother and her brother from father's sister and father, and of wife's father and his sister from mother's brother and mother. Children of these four varieties of kin would present varying degrees of marriageability, and the kinship groups would be defined territorially. Daughter's husband and his sister (son's wife) could be distinguished similarly from sister's children, and the spouses of sister's

children from sons and daughters. A kinship system growing up from this basis would be of the "Aranda" type, and would not pass through the stage of the "Kariera" type where wife's father and mother have the same kinship status as mother's brother and father's sister, and children's spouses have the kinship status of sister's children.

There is, therefore, both actual and theoretical support in favour of the suggestion that the existence of relatively simpler systems of kinship terminology and kinship marriage rule in certain tribes, of which the Kariera is the accepted type, is due to a compromise between matrilineal and patrilineal systems, rather than that the apparently simpler systems represent a prior type in an evolutionary sequence.

References.

1. Brown, Radcliffe A. R. 1913. Three tribes of Western Australia. J. of the R. Anth. Inst. **Vol. xliii.**, p. 143.
2. „ „ „ 1918. Notes on the Social Organisation of Australian Tribes. *Ibid.* **Vol. xlviii.**, p. 222.
3. „ „ „ 1930–31. The Social Organisation of Australian Tribes. Oceania. **Vol. i.**, pp. 34, 206, 322, 426.
4. Cawthorne, W. A. 1844. Rough Notes on the Manners and Customs of the Natives. Proc. of the R. Geograph. Soc., S. Aust. Branch. 1925, p. 46.
5. Dawson, J. 1881. Australian Aborigines.
6. Elkin, A. P. 1931. The Dieri Kinship System. J. of the R. Anth. Inst. **Vol. lxi.**, p. 493.
7. „ „ 1931. The Social Organisation of South Australian Tribes. Oceania. **Vol. ii.**, p. 44.
8. „ „ 1932. Social Organisation in the Kimberley Division. Oceania. **Vol. ii.**, p. 296.
9. Fraser, J. 1892. The Aborigines of New South Wales.
10. Fry, H. K. 1931. A Table Showing the Class Relations of the Aranda. Trans. of the Roy. Soc. of S. Aust. **Vol. lv.**, p. 12.
11. „ „ 1932. Genealogical Studies of Australian Tribal Systems. *Ibid.* **Vol. lvi.**, p. 27.
12. „ „ 1933. Australian Marriage Rules. The Sociological Review. **Vol. xxv.**, p. 258.
13. Grey, G. 1841. Journals of Two Expeditions of Discovery.
14. Howitt, A. W., and Fison, L. 1880. Kamilaroi and Kurnai.
15. Howitt, A. W. 1904. The Native Tribes of South-East Australia.
16. Rivers, W. H. R. 1914. The History of Melanesian Society.
17. Roth, W. E. 1897. Ethnological Studies in N.W. Central Queensland.
18. Smyth, R. Brough. 1878. The Aborigines of Victoria.
19. Spencer, B., and Gillen, F. J. 1899. The Native Tribes of Central Australia.
20. „ „ „ „ „ 1904. The Northern Tribes of Central Australia.
21. Spencer, B. 1914. Native Tribes of the Northern Territory of Australia.
22. Stanner, W. E. H. 1933. The Daly River Tribes. Oceania. **Vol. iii.**, p. 377.
23. „ „ 1933. A Note upon a Similar System Among the Nangiomeri. *Ibid.*, p. 416.
24. Strehlow, C. 1913. Die Aranda- und Loritja-Staemme. Th. iv., Abt. i.
25. Taplin, G., et *Alii.* 1879. South Australian Aboriginal Folk Lore.
26. Woods, J. D. 1879. Native Tribes of South Australia.

NOTES ON THE ABORIGINES OF THE SOUTH-EAST OF SOUTH AUSTRALIA.

PART I.

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[Read May 10, 1934.]

Little has been published concerning the life and habits of the aborigines who occupied that portion of South Australia lying south of the River Murray. Therefore the recording of any further information, however fragmentary, seems fully justified.

The aim of the notes constituting Part I of this survey is to summarise briefly the available sources of recorded data on the aborigines of the South-East of this State, and, in addition, to place on record a few observations collected by the writer.

TERRITORY DEFINED.

As Fenner (1) has pointed out, the term "South-East" has become so thoroughly established that its usage might well be continued. The same writer describes this area as a distinct "natural region," and the description and boundaries which he gives to it have been adopted for present consideration. It is felt that by assuming an identity between the features which constitute the geographer's "natural region" and those which are present in the natives' "tribal beat," we may have a useful basis for considering the distribution of our aboriginal population. A closer appreciation and application of the above-mentioned authority's geographical studies on this State would surely help to clarify and add to the interest of research on its indigenous as well as its modern inhabitants. In other words, the geographical controls of rainfall, temperature, relief, and soils, dominated the existence of the earlier inhabitants just as they do those of the present time.

The "South-East," therefore, is the southernmost portion of the State, and its boundaries, as suggested by Fenner (Map. No. 130), are the coastline, the Interstate border, and an arbitrary "line" stretching with a slight southerly trend from Kingston to the Victorian border. He describes it as consisting of the swampy level-bedded limestone plains which emerge from the drier Mallee Plains of the Murray region, the "Ninety Mile Plains" lying between the latter and the South-East. The south-eastern plains are broken up partly by the remains of volcanic foci in the south and also by "a remarkable series of stranded dunes"; and within the area there is a wide variety of fertility conditions.

RECORDED DATA.

Considering the indigenous inhabitants of this region from published records and maps, we find that the main group which occupied the South-East is known by varied forms of the name applied to it by Mrs. J. Smith—whose account is the most extensive—the "Booandik" tribe. A consideration of this term and the distribution of the tribe will be given in later paragraphs.

The available sources of published information may be briefly summarised as follows.

Mrs. J. Smith (2) wrote the earliest and most extensive account of these aborigines. But while her little book contains much that is of lasting value,

it is somewhat disappointing as an ethnographic record, in that most of its pages are devoted to describing her experiences in an endeavour to Christianise the natives. However, it remains the chief source of information on the South-East aborigines.

Howitt (3) apparently did not make any personal observations on these people, and for his information drew on those of Mrs. Smith and her son, Mr. D. S. Stewart.

Mathews (4, 5) has dealt mainly with their language and grammar, his information being gathered from "a few surviving members" with whom, he states, he was fortunate enough to make personal contact.

Thomas (6) makes brief mention of the Booandik; and although he gives no reference as to his source of information, he has obviously drawn on the records of Mrs. Smith.

Ward's small publication (7) deals with the development of the South-East by the white occupation and makes only occasional reference to its indigenous inhabitants.

Fison and Howitt (8) refer to "the Mt. Gambier tribe" without naming it, and quote remarks and observations of D. S. Stewart.

Curr (9) deals briefly with this tribe; his few pages consisting of some notes on their language and a short vocabulary. His informant was D. S. Stewart, of Mt. Gambier.

East's reference (10) is a brief one, concerned in discussing the distribution of South Australian tribes.

Angas, in the account (11) of his early journey through the South-East, provides some useful and interesting observations.

Schmidt (12) gives only a brief account of the natives here concerned, and has drawn on various of the afore-mentioned for his data.

Brough Smyth (13) makes several brief references to the aborigines of the Mount Gambier district; but these merely quote observations given to Fison by D. S. Stewart. In fact, his large two-volume work gives very little information concerning the natives of the far western region of Victoria; this is unfortunate, because the lower South-East and south-western Victoria are closely related in certain geographical aspects.

Dawson (14) refers very briefly to the natives of "the Mount Gambier district."

Woods (15), in this particular work, is mainly historical, and devotes little space to the aborigines. He refers to those of the Lakes Alexandrina and Albert district, and states that "Further east there were the Booandik, the Tatiara, Padthaway, Naracoorte, and the south-east coast tribes, which occupied the country as far east as the Glenelg River near the Victorian border."

Taplin, in his book on the aborigines of South Australia (16), devotes sections to the Tatiara, Padthaway, and south-east coast tribes; but these pages contain little concerning those under present discussion, and no mention is made of the Buandik.

Worsnop (17) makes a brief reference to the natives near Lake Bonney.

Tribe Synonyms.

The name given to the main inhabitants of the South-East naturally varies with different writers. Mrs. Smith, whose contact with these natives was a close and prolonged one, has termed them the "Booandik." Others, although drawing on Mrs. Smith for their information, have preferred a different spelling of this name, as, for example, "Buandik" (Howitt, Schmidt), as "Boandik" (Ward, East, Woods). Mathews, who secured some of his

information first-hand from a few surviving aborigines, disagreed with the phonetics of Mrs. Smith. He writes: ". . . whose name she erroneously gave as Booandik." He expresses it as "Bungandity." Dawson (p. 76) refers to the aborigines of the Mt. Gambier district as the "Bung'andaetch." It is also interesting to note that the name applied to the immediately neighbouring Victorian tribe has some slight phonetic similarity—the "Gournditch" (see Fison and Howitt, p. 278).

Similarly for neighbouring tribes (or groups of the one main tribe?) we have:—

Pinejunga (Smith), Penganka (Ward), Painchunga (Howitt).
Mootatunga (Smith), Moatatunga (Howitt).
Wichintunga (Smith), Wiatunga (Howitt).
Polinjunga (Smith), Taloinjunga (Howitt).

W. W. Thorpe (18) published an article on Australian tribal synonyms, but his mention of names concerned here is quite incomplete.

To bring the spelling of the name of the main tribe under discussion into conformity with the phonetic values now generally accepted, it is proposed to adhere to the version preferred by Howitt, namely, "Buandik."

Distribution of the Aborigines.

From published records it is difficult to decide whether we should consider the South-East as having been occupied by one large tribe, consisting of a number of associated local groups, each with its own terrain, name, and dialect; or, as Mathews describes them, occupied by "an aggregate of about half-a-dozen small tribes." The following notes will summarise these points according to various writers; but it must be remembered that the term "South-East" has, in the early records, been used in a poorly defined manner.

Mrs. Smith has stated that these aborigines consisted of five separate tribes. Her statement (p. ix.) reads: "The aborigines of the South-East were divided into five tribes, each occupying its own territory, and using different dialects of the same language. Their names were 'Booandik,' 'Pinejunga,' 'Mootatunga,' 'Wichintunga,' and 'Polinjunga'." She states that the Buandik was the largest, and ". . . occupied that tract of country extending from the mouth of the Glenelg River to Rivoli Bay North (Beachport), for about thirty miles inland."

Mathews wrote of the "Bungandity" that they ". . . occupied the country around Mt. Gambier, County of Grey, South Australia, and extended easterly into Victoria as far as the valley of the Glenelg River." The other groups mentioned by Mrs. Smith no doubt make up his ". . . aggregate of about half-a-dozen small tribes, the limits of whose territory may be indicated approximately by a line drawn from Kingston to Bordertown, and thence southerly to the sea coast." (p. 59.)

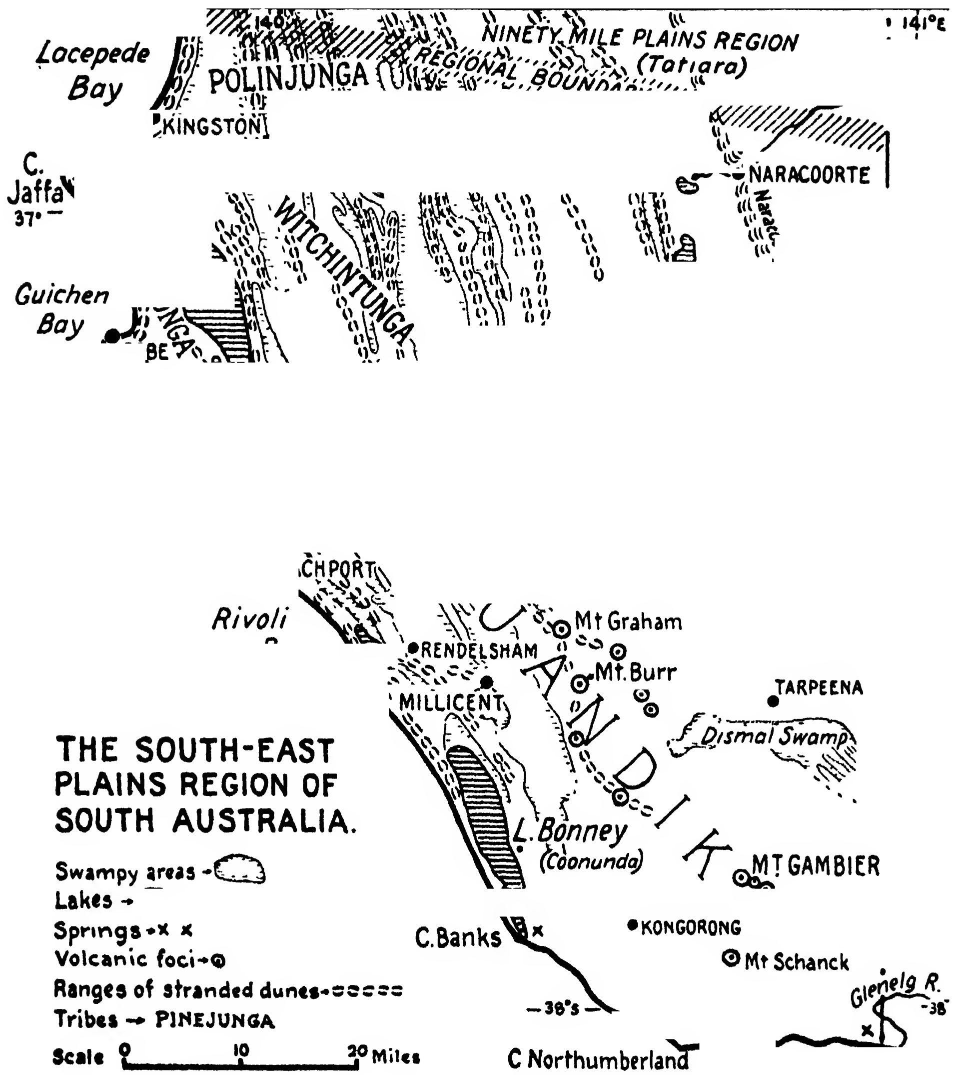
J. J. East (p. 3) describes "The River Murray Tribes" as occupying ". . . the South-East of the province and a portion of the Adelaide hills." One of the three main divisions of this area he terms "The T(h)unga or Coorong Blacks, who reach from Lake Alexandrina to Mt. Gambier." He describes the "Boandiks" as being a tribe of the Thunga section.

Howitt (p. 68) refers to the Buandik as occupying the coast between the Glenelg River and Rivoli Bay. For his details he has drawn mainly on the records of Mrs. Smith and information from Mr. D. S. Stewart.

Dawson, although his work deals almost exclusively with the aborigines of South-western Victoria, makes little reference to those occupying the country which we now term the South-East. In fact, his only statement

which bears on the present discussion is one referring (p. 76) to ". . . the Bung'andaetch who inhabit the Mount Gambier district. . . ." .

One of Ward's references to the natives states that the inmates of the Aborigines' Home—which was located near Mt. Gambier back in the middle of last century—consisted of ". . . descendants of the Penganka and



Boandik tribes, who formerly occupied the country from Mount Gambier to Tatiara. The dominion of the Boandiks comprised the southerly portion of that area, and the Pengankas roamed from Penola northwards." (p. 80.)

It will be seen that several of these writers, in refering to the Buandik, mention them as natives who lived in the Mt. Gambier district; but none of these observers had anything like such close acquaintanceship with them as that of Mrs. Smith, and were probably not aware of the actual tribal distribution.

From general accounts of our Australian aborigines, it may be safely assumed that natural regions, as defined[1] in modern geographical studies, were an important factor in the distribution of the indigenous population. A more favourably endowed region would naturally tend to constitute the territory of a stronger tribe, just as strong topographical features like ranges or barren plains would tend to form natural boundaries between adjacent tribes or groups. As stated above, it is felt that the work of Fenner can be of assistance in studying the native group under present discussion.

In adopting Fenner's definition of the "South-East" and applying to it the somewhat scant information contained in the above extracts from available records, it appears that this area was occupied mainly by the Buandik natives. If we accept Mrs. Smith's statement that their territory extended thirty miles inland from the coast, then it would embrace most of this striking "natural region" composed of alternate ranges (ancient stranded dunes and ridges formed of volcanic cones) and swampy flats.

The sea coast formed the westerly and southerly boundaries of this tribe, while the Glenelg River was probably its south-easterly limit. On the northerly and north-easterly aspects we do not find such definitely limiting boundaries; for on the northern side of the territory attributed to the Buandik, we have a much more open type of country which merges into the "Ninety Mile Plains" (Fenner) or Tatiara region.

Beyond mentioning that the Pinejunga (Penganka, Painchunga) were inland from the Mt. Gambier natives, and the Wichintunga inland from the Mootatunga, or Robe district natives, the published data do not enlighten us concerning the make-up of these northerly neighbours, or of their relationship with the Buandik. Nor do we know much of the still more northerly natives known as the Tatiara (Tattayarra), or Merkanie (East) group.

Concerning the relationship between the Buandik and their easterly neighbours, we know little beyond that—according to Fison and Howitt—their customs and social organisation appear to be somewhat similar. A detailed comparison of Mrs. Smith's data on the Buandik, and Dawson's on the south-western Victorian aborigines, might prove a profitable study.

Present consideration of the published accounts of these natives will now be limited to stating briefly, for the guidance of any further work, the main sources of information bearing on their social organisation and language.

Social Organisation.—SMITH, pp. ix.-xi.; 3-5. FISON and HOWITT, pp. 168-171. HOWITT, p. 250. CURR, pp. 460-463. TAPLIN, p. 61. MATHEWS (5).

Language.—MATHEWS (4), p. 250; and (5). SMITH, p. 125, *et seq.* CURR, vol. iii., pp. 437, 462-465. TAPLIN, p. 142, *et seq.*

Legends.—SMITH, pp. 14-24.

The following notes are the result of observations made by the writer during several vacation trips to the Millicent district. They are largely based on information secured from an old resident of that township, the late Mr. George Wallace, whose experience carried him back to 1859, long before the township was actually established in 1871. The notes cover only a limited range of subjects, nevertheless they contain some interesting points from the clear recollections of an observer of the aborigines before the newly-settled white population had caused complete disorganisation of their life and customs.

[1] A widely accepted definition of a Natural Region is: "An area where the topography, climate, productions, and potentialities may be described with the maximum number of general statements and the minimum number of exceptions"; or "a tract of country stamped with an aspect of unity."

Distribution.—At the time of Wallace's earliest days in the district, the native population was declining, and had become more or less congregated into a number of localized groups, each group being made up of the customary smaller "family groups." These local groups occupied fairly well-defined regions, and those recalled by Wallace were spoken of in his early days as the Robe, Woakwine, Mount Burr, Mayurra, and Kongorong (German Creek) natives. He could not remember any of the aboriginal names for these groups.

To those acquainted with the South-East, it will be obvious that these localities formed topographically suitable hunting and camping areas. All of them were quite reasonable expanses of territory with adequate and permanent water supplies; nearly all included a range or portion of a range; a number of these "beats" were separated by wide areas of almost permanently swampy country.

Robe Section (The Mootatunga of Smith).—These natives had as neighbours the Kingston group or Polinjunga (Smith), who further north linked up with the Coorong natives. This Robe group was almost coastal, but their territory included the many lakes of that district and the north-westerly portion of the Woakwine Range.

Woakwine.—These natives occupied the Rendelsham-Beachport region of the Woakwine Range. This also was practically a coastal beat with Lake Frome and permanent fresh-water swamps as their water supplies. It is interesting to note that Angas (p. 154), when writing of this particular region, stated that ". . . these natives belonged to a tribe totally different from those of the Milmendura whom we had met along the shores of the Coorong, and were very inferior to them in physical appearance: their features were remarkably ugly, with a simple silliness of expression, and their figures extremely slight and attenuated, with the abdomen of a disproportionate size. They were filthy and wretched in the extreme; all their teeth were black and rotten; their skin was dry, and that of one man presented a purplish-red colour."

Mount Burr-Mount Graham.—This range is situated some few miles east of Millicent, separated from the Woakwine Range by a wide and, in past years, very swampy plain. It consists largely of areas of volcanic rocks, mostly tufaceous, and embraces extensive "stringy bark" forests; small lakes occur in the volcanic areas and caves in the limestones.

This area was the location of one of the earliest sheep stations in the South-East, and there are ample records to show how stoutly the natives of this particular territory resisted the usurpation of their home ground.

The following extract from Tolmer's "Reminiscences" (19) is of interest in that it concerns an occurrence which gave rise to considerable official correspondence and enquiry. Writing of Mr. Leake, whose head station was in the vicinity of what is now known as Lake Leake, his journal states (November, 1844):—"He complained sadly of the constant thefts committed by the natives in the neighbourhood, and their constantly dodging his shepherds from tree to tree, shaking their spears and putting them in the greatest fear. At night, notwithstanding the vigilance of his men, they managed to get into the sheepyards and carry away the sheep. He had lost fourteen rams in that way. He said they are very numerous but small in stature, very active and fierce. Not long before, about sixty or seventy attacked the shepherd on the run, and drove him back; although he was well armed, and fired several shots at them, they succeeded in spearing and taking away from thirty to forty sheep. Mr. Leake on this occasion went with his men

in pursuit, and soon came up with the natives in possession of the sheep. They then commenced throwing spears at the Europeans, who immediately fired amongst them, killing one and wounding another. One of the shepherds received a spear wound in his arm during the affray; since this affair, however they have not been quite so bold."

In an official note to Mr. Lillicrap, dated 20th May, 1845, Mr. Leake wrote: "We are attacked on all sides by blacks, if something be not done it will not be safe to go in any part of the country."

Mayurra.—This territory consisted of that portion of the Woakwine Range to the immediate west of Millicent. It was associated with the coast a few miles still further to the westward. Besides other water supplies, this beat adjoined the northern end of Lake Bonney (sometimes termed Lake Coonunda), a fine stretch of water about twenty-five miles in length.

Kongorong.—A tract of country west of Mount Gambier and adjacent to the southern end of Lake Bonney. This district was also known locally as the "German Creek."

The above-mentioned localities were all well watered and thickly timbered areas. That they abounded in native game in the early days of civilized settlement is amply substantiated by early records, and the conditions of climate and food potentialities probably made these districts capable of holding a larger native population than that suggested in Wallace's statements on their numbers in his early days.

These subdivisions mentioned by Wallace might well be looked upon as the actual remnants of definite local groups of the Buandik tribe, and probably constituted most of the sections into which they were divided before detribalization had commenced through white man's intrusion into their homeland. But from our consideration of the published records it seems that we must add at least one more local group, namely, that occupying the Mt. Gambier region; possibly others also, as the following extract indicates.

A report from E. P. J. Sturt, J.P., of Mt. Gambier, to the Colonial Secretary, 30th April, 1846, contains the following: " . . . the natives have (as the winter approaches) been mustering in great numbers, and are united with many of the Glenelg tribe, numbers of which have left that River owing to the numerous murders and depredations committed by them. This circumstance will, I fear, render them seriously troublesome for some time."

Population.—According to Wallace, these local groups consisted of roughly sixty to a hundred individuals; each group, of course, being made up of the usual small family groups.

Language.—My informant had no personal knowledge of the language, but said it was generally accepted that these local groups spoke slightly different "dialects," but were able to converse quite readily one with another.

Domestic Life.—The smallest family group generally consisted of a monogamous union—although occasionally a man might have two wives—and an average of two or three children. Mrs. Smith has stated that ". . . polygamy was the rule: most of them had two wives, but some had as many as five."

Their wurlies were constructed of boughs; skins were only rarely used to ensure more effective shelter.

The only clothing Wallace could recall as being in regular use was a sort of girdle or "skirtlet" of emu feathers.

Their bodies were scarred in the manner customary with the Australian aborigines.

Their diet seemed to consist largely of kangaroo, opossum and emu, all of which were abundant. He could not recall having seen any fishing activities even though lakes and almost permanent swamps and lagoons existed in the district. Smith (p. xi.) includes fish as one of the chief items of diet. The same writer mentions "fine roots" and "candart-seed." It seems likely, of course, that cereals and other vegetable foods were used by these aborigines, but it is an interesting point that enquiries and examination of many camp sites have failed to bring under notice the use or existence of the typical large grinding stones used by the natives in food preparation.

Mrs. Smith mentioned the making of fire with "grass tree sticks" by the rotary method. Wallace said he had never personally observed the making of fire, but had often noticed how particular they were to keep their fires going. In order to make a fire in another place they would carry a piece of burning sheoak bark.

Angas (vol. i., p. 155) mentions an interesting point concerning fish catching by these natives. During his journey he observed in the region just inland from Rivoli Bay (Beachport):—"On some of the swamps that natives had built weirs of mud, like a dam wall, extending across from side to side, for the purpose of taking the very small mucilaginous fishes that abound in the water when these swamps are flooded." He also writes of them using large haliotis shells for carrying water, and drinking an infusion made from the cones of the Banksia.

Stone Implements.—The present writer has made collections of stone implements from many camp sites in the district under discussion. Implements of the smaller varieties are fairly representative of those found on native camp sites in general; even to the small microlithic types like the so-called "crescent" and "chipped-back knives." But on the whole the south-eastern implements do not show the symmetry in design and technique which characterises those from many of the far northern parts of the State. Although true flint is abundant on certain limestone formations both on coastal and other regions of the South-East, the native implements are, for the most part, lithoclastically unattractive. Wallace stated that he had frequently seen in use the polished stone tomahawk, typical of the South-East; but always as a hand chopper, and not hafted in a handle. The numbers of axe heads which have been collected in this lower part of the State are considerable; it must have been a very common implement. It is generally accepted that these native axe heads were traded across from one or other of several well-known sources in Victoria, the material from which they are formed being quite foreign to this region.

It would be interesting to hear confirmation of Wallace's observation that the stone axe heads were so much used without being mounted. It is well known that the white man's iron tomahawk was, at an early date, introduced into the natives' equipment (Sturt describes his own distribution of them among the natives during his classic journey down the River Murray). By Wallace's time, the use of the native stone axe head as a hand-gripped implement may represent a degenerative stage of its usage.

Wood Implements.—Wallace stated that almost all the native wooden implements were made from sheoak (Casuarina).

Spear shafts were secured from the ti-tree (Melaleuca), which, of course, is still abundant in certain swampy areas of the South-East. The spear shaft was pointed, and had a wood barb attached.

Boomerangs of both the ordinary and returning varieties were used.

A pick-shaped implement made entirely of wood was fairly common.

The natives used a bird snare consisting of a stick about eight feet long with a running noose attached to its end. The noose string was made from kangaroo sinew.

An interesting reference to wood implements occurs in the following extract, taken from an official report, dated 28th February, 1865. Ranger Egan, reporting on the natives of the Tarpeena district, wrote that ". . . a great mob of them went away to the mallee scrub for spears and waddies. The scrub is more than 100 miles from this. I met them in the Province of Victoria returning with large quantities of those warlike instruments."

Hunting.—Wallace was definite on the method of bird snaring, which does not seem to have been recorded very often for the Australian native. As mentioned above, it consisted of a long stick with a noose at its end. It was largely used for catching wild turkey. The hunter would conceal himself in a clump of bushes, and the bird, being of an inquisitive disposition, would be attracted by movements judiciously executed by the native. The latter, with his customary patience, waited until a suitable moment when he would slip the noose over the bird's head. This form of bird snare has been recorded by several writers, and their accounts correspond with the above and also give some further details: Angas (vol. i., p. 148), Thomas (p. 97), Pyke (Ref. 20, p. 58), Brough Smyth (vol. i., pp. 192-196, and vol. ii., p. 314). This exquisite point of hunting technique on the part of the Australian native is one which I have heard stressed by more than one observer. He undoubtedly possessed consummate skill and patience in getting himself and his prey into close proximity, and remaining perfectly stationary until that fleeting but sufficient moment when his quarry allowed its attention to be directed elsewhere. His missile or snare was then put into action with lightning rapidity. Wallace informed me that he had actually seen a native catch a wild pigeon by this snaring method. He also stated that although he had not witnessed the natives catching wild duck, it was locally quite accredited that in securing duck they would quietly swim up to the birds, very quickly drag one under the water and screw its neck, all with scarcely any observable commotion. This method has, of course, been recorded for the aborigines in various places. They also showed the customary native skill in spear throwing; and he knew a noted spear thrower named Billy who could kill parrots by this means.

Customs and Ceremonies.—My informant expressed no knowledge of initiation ceremonies, if such were practised. Mrs. Smith makes no mention in her work of initiation customs or ceremonies. Concerning the eastern neighbours of the Buandik, Fison and Howitt make a note (p. 193): "The Gournditch-mara tribe of Western Victoria, according to the Rev. J. H. Stahle, had no initiation ceremonies." Another reference to the same effect occurs on p. 278.

Smoke signals were commonly used to attract attention between parties of aborigines, but Wallace was not aware of any message system by such means.

The natives of the district were accustomed to meet for what he took to be friendly gatherings. These mostly took place in the vicinity of Mt. Burr. Messengers would be sent to various groups, who would agree to meet in so many moons time. They came from as far as Kingston and the Coorong. The meeting seemed to be mainly for corroboree purposes. They generally became quite excited, and worked up into a fight, during which someone would be seriously injured or even killed; then all the fighting would cease. Otherwise, to Wallace, these corroborees seemed uninteresting affairs. The

womenfolk did the singing and beat their sticks on rolled-up opossum skin rugs, while the dancing consisted chiefly of a simple leg-shaking sort of dance. He knew of one corroboree occasion when a native named Billy Glen—who was an expert spear thrower—had secured some drink and became very excited. As a challenge for somebody to come out and have a duel with him, he threw a spear some distance into a neighbouring camp. It passed through the wall of a wurlie and through the back of a man who was sitting beside his fire. Billy was taken along, and the fatally injured native was given one of the pick-shaped implements, and as well as he could he belted Billy over the head with many blows. The latter was almost killed by the injuries, and died not long after the event.

Mrs. Smith has stated (p. ix.) of these natives that ". . . although they occasionally met on friendly terms to hold a 'murapena' (corroboree), it usually eventuated in a fight, in which one or two were killed and afterwards eaten."

Burial.—My informant related his observation of an interesting example of the "platform" burials which have been recorded for the Coorong region. On one of his stock-droving trips to the Adelaide district they heard of some native burials on a small island situated in a lagoon near Salt Creek. He asked their blackboy to show them the place, but the native persistently refused, saying it would mean death to him. Wallace and his companions found the spot, and the burial consisted of two bodies on a platform—said to be "king and queen." Arranged below and around the platform was a circle of seven or eight other bodies placed in a sitting posture.

Another informant stated that he had seen several native bodies unearthed in the Millicent district, and all the skeletons were in a sitting posture with the limbs flexed.

Angas mentioned (vol. i. p. 158) that near Rivoli Bay, "On a grassy knoll, surrounded by sheoaks, we met with a mound of limestones, like a cairn, which we conjectured to have been placed there by the natives above the bodies of their dead to protect them from the wild dogs."

The writer desires to record his thanks to Dr. Fenner and Mr. N. B. Tindale for helpful suggestions in the compilation of these notes.

Summary.

The amount of published information concerning the life and customs of the natives of the south-east of South Australia is scant.

Part I of this study contains the sources of information published as scientific communications.

The South-East was mainly occupied by a tribe, or collection of local groups of aborigines, who were first described as the "Booandik" tribe. It is suggested that "Buandik" be adopted as the preferable spelling of this name.

Little has been written of the groups who linked up the Buandik with those of the Coorong and the better known Narrinyeri groups; or of those who inhabited the region between the Buandik and the more northerly people of the Tatiara (Tattayarra) or Ninety Mile Plains country.

Mention is made of the relation between "natural regions" and tribal territories.

Some observations and notes collected by the writer during recent years are included.

The object of the paper is to pave the way for further and more intensive research on the little known aborigines who inhabited the southernmost parts of South Australia.

REFERENCES.

1. FENNER, CHARLES—"South Australia. A Geographical Study" (1931).
2. SMITH, MRS. JAMES—"The Booandik Tribe of South Australian Aborigines," Adelaide (1880).
3. HOWITT, A. W.—"The Native Tribes of South-East Australia" (1904), pp. 68, 250.
4. MATHEWS, R. H.—"Language of the Bungandity Tribe, South Australia." Proc. Roy. Soc. N.S.W., **vol. xxxvii.** (1903), p. 59.
5. ———— "The Victorian Aborigines." American Anthropologist, **vol. xi.** (1898), pp. 331-336.
6. THOMAS, N. W.—"Natives of Australia," London (1906), p. 246.
7. WARD, E.—"The South-Eastern District of South Australia," Adelaide (1869), p. 80.
8. FISON, L., and HOWITT, A. W.—"Kamilaroi and Kurmai" (1880), p. 168.
9. CURR, E. M.—"The Australian Race" (1887), **vol. iii.**, p. 460.
10. EAST, J. J.—"The Aborigines of South and Central Australia." Pamphlet read before Field Nat. Sect. of Roy. Soc., S. Aust., July 16, 1889, p. 3.
11. ANGAS, GEORGE FRENCH—"Savage Life and Scenes in Australia and New Zealand" (1847), **vol. i.**
12. SCHMIDT, P. W.—"Die Gliederung der Australischen Sprachen," Wein. (1919), p. 75.
13. SMYTH, R. BROUGH—"The Aborigines of Victoria" (1878). 2 Vols. **Vol. i.**, pp. xxvi., 92, 235; **vol. ii.**, p. 269.
14. DAWSON, J.—"Australian Aborigines," Melbourne (1881), p. 76.
15. WOODS, J. D.—"The Province of South Australia," Adelaide (1894), p. 399.
16. TAPLIN, G.—"The Folklore, Manners, Customs, and Languages of the South Australian Aborigines," Adelaide (1879).
17. WORSNOP, T.—"Aborigines of Australia," Adelaide (1897), p. 149.
18. THORPE, W. W.—"Australian Tribal Names with their Synonyms," Rec. Aust. Mus., **vol. viii.**, pt. 4 (1913), p. 162.
19. TOLMER, ALEX.—"Reminiscences," London (1882), **vol. ii.**, p. 13.
20. PYKE, W. T.—"Thirty Years Among the Blacks of Australia," London (1904).

THE MONTHLY PRECIPITATION-EVAPORATION RATIO IN AUSTRALIA, AS DETERMINED BY SATURATION DEFICIT.

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[Read May 10, 1934.]

During an investigation of the geographical distribution and seasonal occurrence of the "springtail" *Smynthurus viridis* L. (Collembola) in Australia, an attempt was made to interpret the moisture "conditions" at the soil surface, during each month, in certain States of the Commonwealth (Davidson, 1933, 1934).

The degree of wetness or dryness at the soil surface during any defined period is determined primarily by rainfall; soil type and its vegetative covering are important secondary factors. The efficiency of rainfall in this respect depends upon the amount and distribution of precipitation (number of rain days), together with run-off and percolation through the soil, in relation to the loss due to evaporation. When evaporation exceeds precipitation, dry conditions may obtain, the intensity of which will depend upon the duration of the period and the rainfall-evaporation ratio.

Several authors have devised formulae for the purpose of expressing the intensity of aridity in an area. In general these formulae are based on consideration of average values, for the year, of certain of the major climatic factors, namely rainfall, temperature, saturation deficit and evaporation. Certain of these formulae have been discussed with reference to Australia by Prescott (1931, 1934) and Andrews and Maze (1933). The latter authors defined the monthly conditions of aridity in Australia using de Martonne's index $\frac{P}{T+10}$, in which the precipitation in millimetres is related to temperature in degrees centigrade. They decided against the use of the climatic factors of relative humidity and evaporation for this purpose for various reasons, chiefly owing to the scarcity of records over a large portion of Australia. As regards saturation deficit, they state "the conception of saturation deficit is still a comparatively new one." It may be observed that the relation of evaporation from a free water surface to the vapour pressure deficit of the air is a fundamental law which was established by Dalton in 1798. Various formulae which have been used to express this relationship, with a view to measuring the loss of water due to evaporation, are discussed by Rohwer (1931).

For the purpose of the ecological studies referred to above, the writer desired to express the efficiency of precipitation in relation to the moisture at the soil surface, month by month, in the southern portion of the Commonwealth. Where records for evaporation and precipitation are available, the rainfall-evaporation ratio in an area affords a valuable guide in this respect (fig. 1).

Evaporation is governed by the temperature, relative humidity, pressure and movement of the air. The measurement of evaporation affords a concise expression of the loss of water from an exposed surface, but the character of the evaporating surface in nature, namely the soil and its vegetative covering, offers considerable difficulty owing to its complexity and variability; the difficulty of obtaining precise values for movement of the air (wind) in local situations is also

important. The values to be assigned to these variables cannot be adequately expressed at the present stage of our knowledge, therefore any formulae which may be used to evaluate evaporation in nature can be expected to give only a general approximation to the actual values. From an ecological point of view,

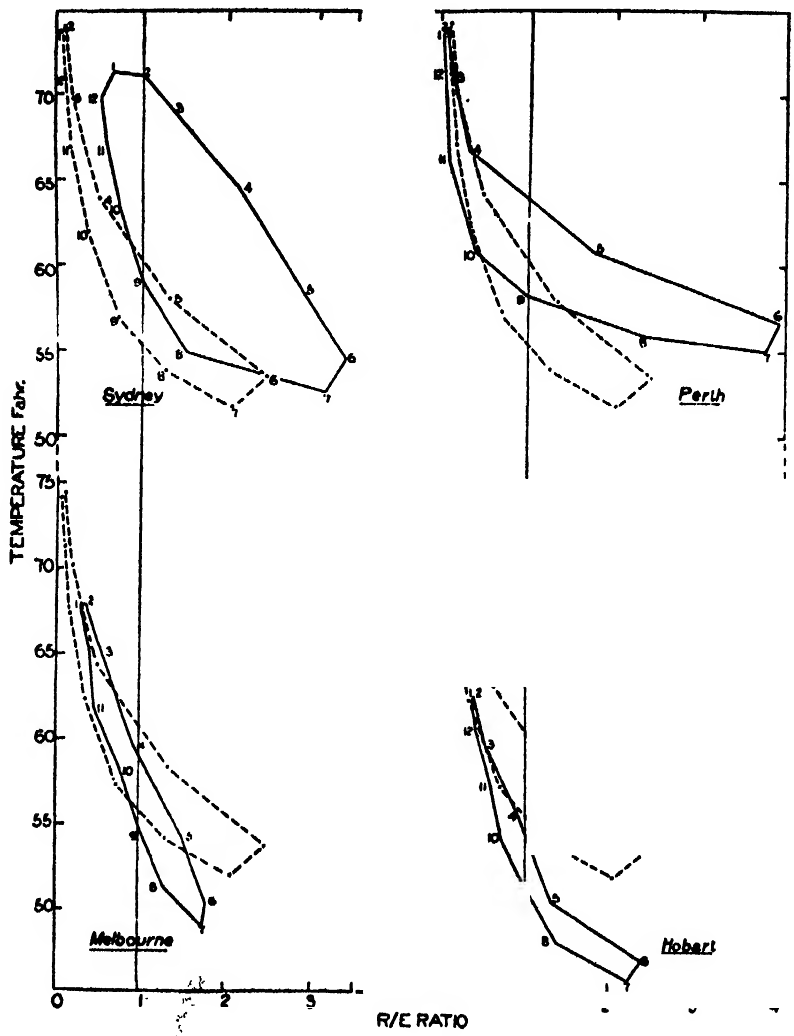

Fig. 1.

Showing the relation of mean monthly R/E ratio and temperature at four capital cities in Australia, compared with Adelaide (broken line). The data are from actual records, Official Year Book, Commonwealth of Australia, 1930. The vertical lines drawn through the graphs represent rainfall equals evaporation. (From Davidson, J., C.S.I.R., Bull. 79, 1934.)

however, the formulae are valuable in studies relating to the effect of climate on the distribution and seasonal abundance of animals and plants.

The vapour pressure deficit of the air (saturation deficit) is the major factor influencing evaporation. It is a function of the temperature and relative humidity of the air and can be calculated for stations where these data are available. From

Dalton's law of evaporation it is known that the intensity of evaporation in a controlled atmosphere is almost proportional to the saturation deficit of the air.

The writer employed a method, with reference to South Australia, whereby the mean monthly values for saturation deficit, calculated for 21 stations, could be expressed in terms of evaporation by reference to evaporation records for Adelaide. By this means the approximate areas in the State, in which the mean rainfall (recorded) exceeds the mean evaporation (calculated), were defined for each month. The areas for each month were then superposed and a composite map was obtained showing the areas and months in which the mean rainfall exceeds evaporation (Davidson, 1933). The same method was used in a later paper (Davidson, 1934) with reference to Western Australia, Victoria, Tasmania and New South Wales. Values for saturation deficit were calculated for 17 stations in Western Australia, and for 45, 15 and 36 stations, respectively, in the remaining States. Values for evaporation at these stations were obtained by reference to the evaporation records for Perth, Melbourne, Hobart and Sydney, respectively. The same method has been applied to the remaining parts of the Commonwealth. Values for saturation deficit were calculated for 85 stations in Queensland, and 16 stations in the Northern Territory and northern portion of Western Australia. Values for evaporation at these stations were obtained by reference to evaporation records for Brisbane and Alice Springs, respectively.(1) With the information obtained a map of Australia was prepared, on a scale 1 inch = 48 miles, showing the months and approximate areas in which the mean rainfall exceeds evaporation as determined by saturation deficit. This is the map presented with the present paper.

The southern portion of Australia lies in the zone of winter rainfall. In the northern portion of the continent the greatest precipitation occurs during the summer. The zones of winter and summer rainfall type are indicated on the map; the boundaries have been taken from the official map of the Commonwealth Bureau of Meteorology, showing the mean monthly distribution of rainfall over Australia, revised up to 1925 (January, 1927).

The greatest precipitation occurs over the coastal belt; the rainfall decreases progressively with increased distance from the coast.

In the zone of winter rainfall, low temperatures and high humidity during the winter are accompanied by relatively low evaporation. Therefore adequate moisture is maintained at the soil surface over a relatively wide area, particularly during June and July; with the onset of the dry season conditions become increasingly dry (fig. 1).

In the northern portion of the Continent, on the other hand, low rainfall during the winter months results in a relatively low rainfall-evaporation ratio, which may result in dry conditions; during the period of greatest precipitation, high temperatures are accompanied by relatively high evaporation. These factors restrict the area in which adequate moisture conditions are maintained at the soil surface, as is shown by the shaded areas on the map.

The moisture conditions on the surface soil are important in relation to the fauna of the soil surface; they are also important in relation to the germination of seeds and the growth of seedlings. In general, however, plant growth depends upon the moisture in the deeper layers of the soil. Where temperature is favourable, vigorous growth of certain plants, for instance grasses, will occur in an area where the surface conditions are dry, so long as moisture is available in the lower depths of the soil. This is a feature of the grassland areas of Queensland and

(1) The necessary data were obtained in the Official Year Book, Commonwealth of Australia, 1932; and Pamphlet No. 42, Commonwealth C.S.I.R. (1933).

Northern Australia. The rate at which the soil moisture is used up will depend upon the transpiration activity of the plants and the intensity of evaporation in relation to rainfall. Therefore the duration of the periods having particular values for R/E are important when considering the ratio as an index of aridity.

It is evident that the monthly R/E ratio may be a useful single factor index for defining aridity in Australia month by month. It will be necessary, however, to define the intensity of aridity which may be associated with particular values for R/E. The critical value for this ratio is $R/E = 1$, the total precipitation and evaporation for the month being balanced, particulary when rainfall is generally distributed (number of rain days). As the ratio exceeds one, the conditions will become increasingly wet, until saturation is maintained, when there may be excessive run-off or flooding. As the ratio falls below one, the conditions will become increasingly dry, the intensity of which will depend upon the value of the ratio and its duration.

REFERENCES.

1. ANDREWS, J., and MAZE, W. H. 1933. Proc. Linn. Soc. N.S.W., **vol. lviii.**, 105-120.
2. DAVIDSON, J. 1933. Australian Jl. Expt. Biol. Med. Sci., **vol. xi.**, p. 59-66.
3. DAVIDSON, J. 1934. Commonwealth C.S.I.R. Bull. 79.
4. PRESCOTT, J. A. 1931. Commonwealth C.S.I.R. Bull. 52, p. 32.
5. PRESCOTT, J. A. 1934. Proc. Roy. Soc. S. Aust., **vol. lviii.**, pp. 44-57.
6. ROHWER, C. 1931. U.S. Dept. Agric., Washington, Techn. Bull. 271.

ON THE AUSTRALIAN SPECIES OF JAPYGIDAE (THYSANURA).

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[Read May 10, 1934.]

Most of our knowledge of the Japygidae of Australia, and of the world as a whole, is due to that great authority on the group, Prof. F. Silvestri.

Hitherto the following twelve species have been described from Australasia, eight of them being confined to Australia:—

Japyx longiseta Silv.	West Australia
Japyx mjöbergi Silv.	Queensland
Japyx tillyardi Silv.	South Australia
Japyx leae Silv.	Tasmania
Japyx froggatti Silv.	New South Wales
Japyx michaelseni Silv.	West Australia
Indjapyx papuasicus Silv.	Papua
Indjapyx sharpi Silv.	Hawaii
Heterojapyx novae-hollandiae Verh.	New Zealand
Heterojapyx victoriae Silv.	Victoria
Heterojapyx gallardi Till.	New South Wales
Parajapyx samoanus Silv.	Samoa

In this paper are described three new species of *Japyx*, two of *Heterojapyx* and one of *Parajapyx*. In addition, new records extend the range of distribution of some of these species within Australia.

I am greatly indebted to many friends for the opportunity of studying the material dealt with in this paper, and tender my thanks to them. In particular I would mention Prof. G. E. Nicholls and his students of Perth University who, in January, 1933, visited the south-west of Western Australia and brought back what probably constitutes one of the largest collections of these insects ever made in a single locality; no fewer than twenty-nine specimens were obtained, representing two known and one new species. Other specimens have been received from Western Australia through the kindness and enthusiasm of Mr. L. J. Glauert (of the Perth Museum) and Mr. D. C. Swan. In addition, I have other examples personally collected in the same State in 1931-2.

From Dr. R. J. Tillyard I have received material collected on Mount Kosciusko, Federal Territory. Mr. J. W. Evans also found a specimen in the same region, and in addition has given me a number of specimens from the Nelson District of New Zealand. In South Australia a number have been collected by Dr. J. Davidson, Mr. D. C. Swan, and the writer.

In the collections of the South Australian Museum there were previously two specimens, mounted on card, collected by the late Mr. A. M. Lea in Queensland and New South Wales.

The specific characters of the Japygidae are so obscure that it is very difficult to construct a serviceable key for their separation. At the conclusion of this paper I have attempted a key to the Australian species, which it is hoped will be serviceable as far as these species are concerned. It is, however, essential to consider the full description of each species before a final determination can be made.

Genus Japyx Halliday, 1863.

Japyx tillyardi Silv., 1930.

Of this species I have seen eight specimens altogether, all taken by Prof. Nicholls and his students. The localities and the number of specimens from each are:—Frankland River, South-West Australia, January, 1933 (2); Walpole Inlet, South-West Australia, January, 1933 (2); and Swarbrick, South-West Australia, January, 1933 (4).

Figs. 1-5.
Japyx tillyardi Silv.—1, forceps from above; 2, subcoxal organ of first abdominal sternite; 3, 4, 5, postero-lateral corners of tergites V., VI., and VII., respectively.

A close study of this material shows some minor differences from the description as given by Silvestri of the type from Mount Lofty, South Australia. The most important is that in all specimens the postero-lateral corners of tergite V. are slightly produced and not rounded.

Japyx froggatti Silv., 1930.

Sixteen specimens of this species were collected by Prof. Nicholls' party at Walpole Inlet, South-West Australia, in January, 1933. I have also seen a single specimen taken at Pinjarra, West Australia in September, 1931, by Mr. D. C. Swan.

Japyx michaelseni Silv., 1930.

Syn. *Japyx longiseta* Silv., 1908 *(ad partem)*.

This species was originally described from West Australia, but I have a specimen collected by Mr. J. W. Evans at Whangamoa, near Nelson, New Zealand, in which I can detect no difference from Silvestri's description.

Japyx mjöbergi Silv., 1928.

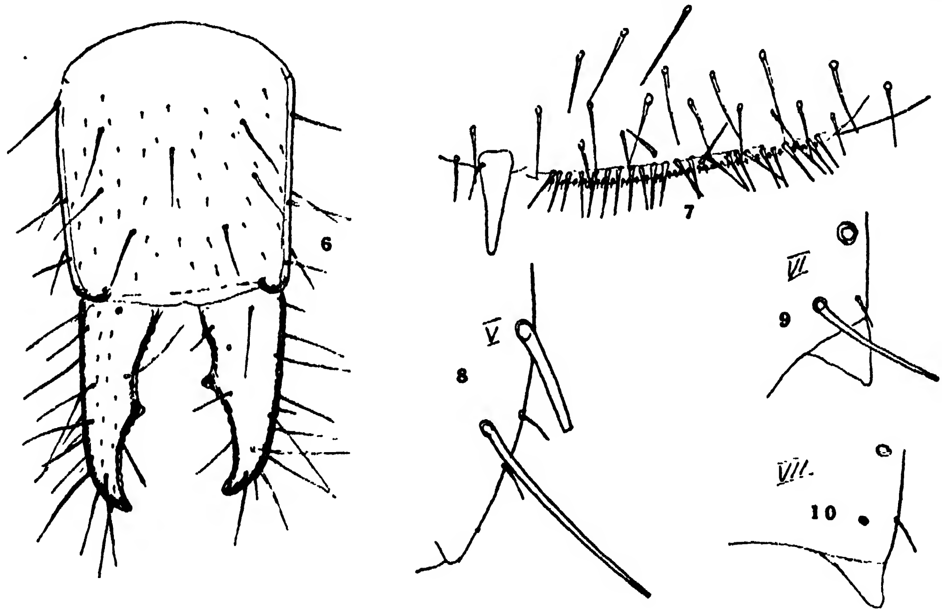
I have before me two specimens which conform to the description of this species. One was found in soil in my garden at Glen Osmond, Adelaide, South Australia, in 1933. The other was taken by Mr. Swan, also at Glen Osmond, in May of the same year.

Japyx longiseta Silv., 1908.

A single example collected by Mr. Swan at Pinjarra, West Australia, in September, 1931, can be referred to this species.

Japyx westraliense, n. sp.

Description.—Colour, cream, except on abdominal segments VIII.-X., which are yellowish, and the forceps, which are of a still deeper yellow. Head above with 15-16 long setae and a few shorter ones on each side. Antennae 24-segmented, segment III. rather longer than wide, the longer setae 0·15 mm., segment X. as wide as long, ultimate and penultimate segments only slightly elongated, the last slightly shorter than the last but one, all segments except the last two with the setae in two well-defined rows, the last with the setae not so orientated, sensory setae on IV.-VI. 3-3-4, these slightly shorter than the ordinary setae; maxillary palpi with 4 pectinate inner lamellae and an inner process; labial palpi elongate



Figs. 6-10.

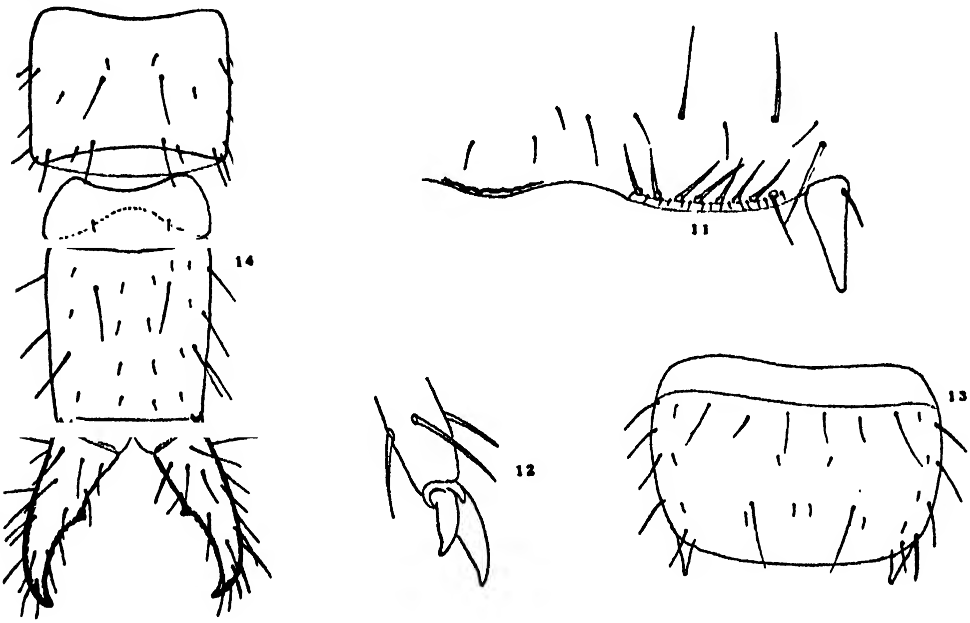
Japyx froggatti Silv.—6, segment X. and forceps from above; 7, subcoxal organ of first abdominal sternite; 8, 9, 10, postero-lateral corners of tergites V., VI., and VII., respectively.

380 μ. long by 180 μ. wide. Thorax: pronotum with 3 very long setae on each side, 4 shorter ones on each side and a few others still shorter; meso- and metanotum with 2 long submedial setae on the praescutum, 3 very long setae, 2 shorter ones and a few still shorter on each side of scutum. Legs: tarsus twice as long as praetarsus with 3 + 3 setae below; hind claw about twice as long as front claw, median claw small but well developed. Abdomen: tergite I. with a pair of fairly submedian praescutal setae and a pair of rather long submedian subposterior scutal setae; tergite II. with a pair of rather short submedian praescutal setae and 3 long, 3 short and a few shorter setae on each side of the scutum; III.-VII. with 6 long, 3 short and some shorter setae on each side; VIII. with 4 long setae on each side; postero-lateral angles of tergites V.-VI. rounded, VII. produced in a short finger-like process, VIII. rounded. First abdominal sternite as figured. Stylets and vesicles normal. Segment X.

of abdomen about one-third longer than wide, very slightly tapering behind, lateral carinae indistinct, with one median subanterior seta, 6 long setae and other short and still shorter ones on each side. Forceps symmetrical, each arm with a large praemedial tooth, between this and the base with 2-3 small rounded tubercles, and postdentally with 10 gradually diminishing tubercles. Length of animal, 7-8 mm.

Holotype and *allotype* from Pinjarra, West Australia, September 28, 1931, collected by Mr. Swan. Another example was taken at Goyamin Pool, Chittering, West Australia, by Mr. Swan on October 19, 1931, and I found one myself at Kelmscott, West Australia, in 1932. Two more were collected by Prof. Nicholls at Armadale, West Australia, in June, 1932.

The relationships of this species to others of the genus are best given by the key.



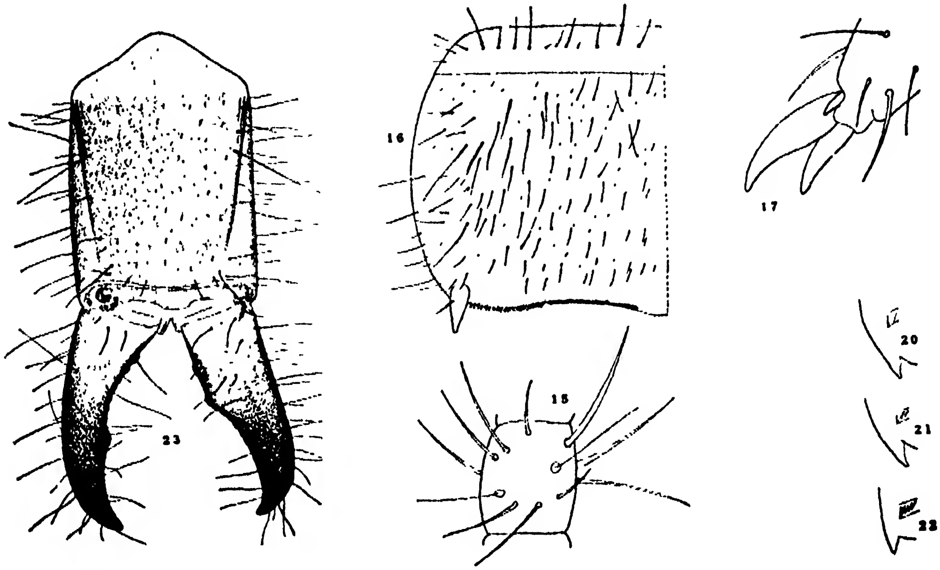
Figs. 11-14.

Japyx westraliense, n. sp.—11, subcoxal organ of first abdominal sternite; 12, foot; 13, tergite VII.; 14, abdominal segments VIII.-X. and forceps from above.

Japyx glauerti, n. sp.

Description.—Colour, deep yellowish cream, considerably darker on abdominal segments VIII.-X., and still more so on forceps, especially towards the tips. Head: antennae 42 segmented, sensory hairs on IV.-VI. as in other species. Abdominal tergites with the postero-lateral angles produced in IV.-VIII., as figured. Tarsal claws as in other species (*cf.* fig.). Subcoxal organ on first abdominal sternite as figured. Abdominal segment X. slightly longer than wide with distinct lateral carinae. Forceps longer than segment X., asymmetrical, left arm with a postmedian tooth, between this and the base with $\frac{7}{8}$ teeth gradually diminishing towards large tooth, the basal ones being rather flattened, postdentally the inner edge of arm is crenulate; right arm with large praemedian tooth, between this and the base with a single rather large tubercle, from tooth to apex strongly concave with 13 to 14 tubercles gradually diminishing into crenulations. Length of animal, 28 mm.

Type.—A single specimen collected by Mr. L. J. Glauert, of the Perth Museum, at the Serpentine Falls, West Australia, in 1925.



Figs. 15-23.

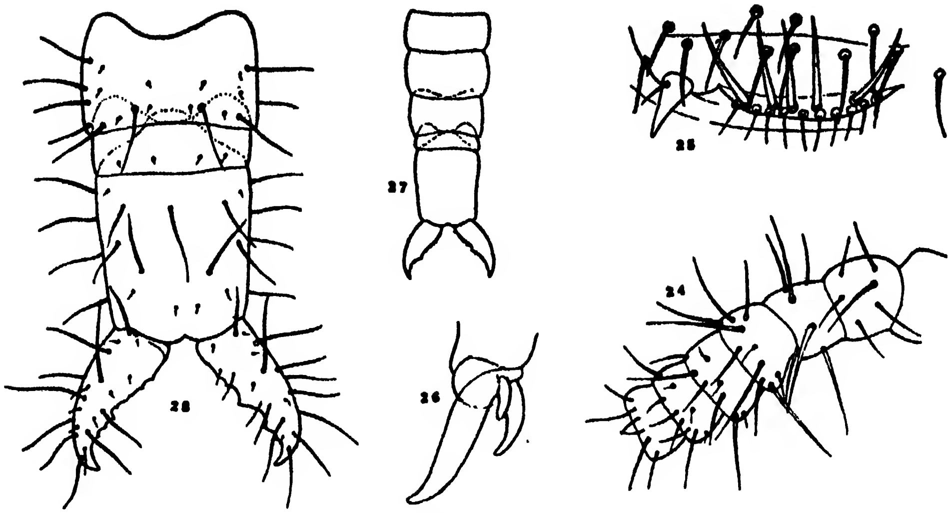
Japyx glauerti, n. sp—15, segment IV. of antennae, showing sensillae; 16, left half of sternite I., showing subcoxal organ; 17, foot; 18-22, postero-lateral corners of tergites IV.-VIII., respectively; 23, segment X. and forceps from above.

Japyx nichollsi, n. sp.

Description.—Colour: white, segment X. lightly yellow, forceps a little darker. Head: a little longer than broad, with 16 long setae and a few shorter ones on each side; antennae 26 segmented, III. longer than broad with setae 0·35 mm. long, IV.-VI. with the usual sensory setae but these are relatively short and thick, X. broader than long, ultimate and penultimate segments not longer than broad. Maxillary palpi normal with 4 pectinate inner lamellae and inner process. Labial palpi elongate 60 μ. long by 20 μ. wide. Pronotum with 3 very long setae and 4 shorter ones on each side; meso- and metanotum with a pair of fairly long submedial praescutal setae, with 4 very long and 6 shorter and many minute setae on each side, and with only minute postscutal setae; tergite I. with 1 long and 4 short setae, tergite II. with 3 long, 2 short and 5 shorter setae on each side, III.-VII. similar, VIII. with 3 long and a few minute ones on each side, X. with 1 long medial subanterior seta and 6 long setae on each side. Legs and claws normal (*cf.* fig.). First abdominal sternite with subcoxal organ, as figured. Forceps subequal to segment X. in length, asymmetrical, left arm with only moderately large postmedial tooth, between it and the base with sinuous inner margin and five small acute teeth the basal two of which are somewhat longer than the others, postdentally with two small acute teeth; right arm with large slightly postmedial tooth, praedentally with 3 acute teeth, postdentally with one small acute tooth and one rounded tubercle. Length of animal, 5 to 6 mm.

Syntypes.—Five specimens collected by Prof. Nicholls and his students at Frankland River, South-West Australia, in January, 1933.

Remarks.—While this species is definitely distinct from all others none of the specimens were completely mature, all lacking genital organs.



Figs. 24-28.

Japyx nichollsi, n. sp.—24, first seven antennal segments; 25, subcoxal organ of first sternite; 26, foot; 27, abdominal segments VI.-X. with forceps; 28, abdominal segments VIII.-X. and forceps more enlarged.

Genus HETEROJAPYX Verhoeff., 1904.

The main character separating this genus from others is to be found in the structure of the tarsi. At the base of each claw is a short, stout conical process or empodium. The species of *Heterojapyx* are also, as a rule, of much greater size but, apart from the dentition of the forceps, few specific distinctions are to be found.

HETEROJAPYX NOVAE-HOLLANDIAE Verhoeff.

I have before me a specimen of this species collected by Mr. E. S. Gourlay on Dun Mountain, Nelson, New Zealand, on November 29, 1927, at 2,000 feet. It

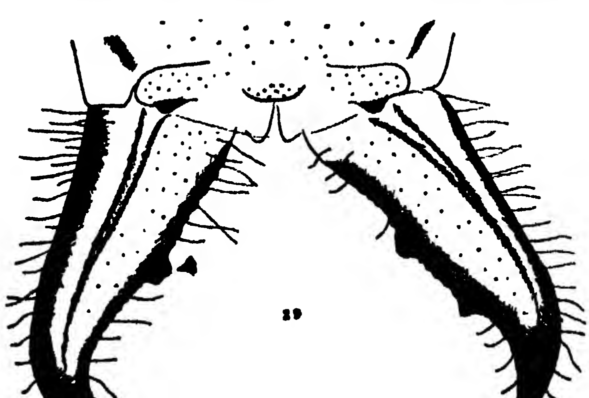


Fig. 29.

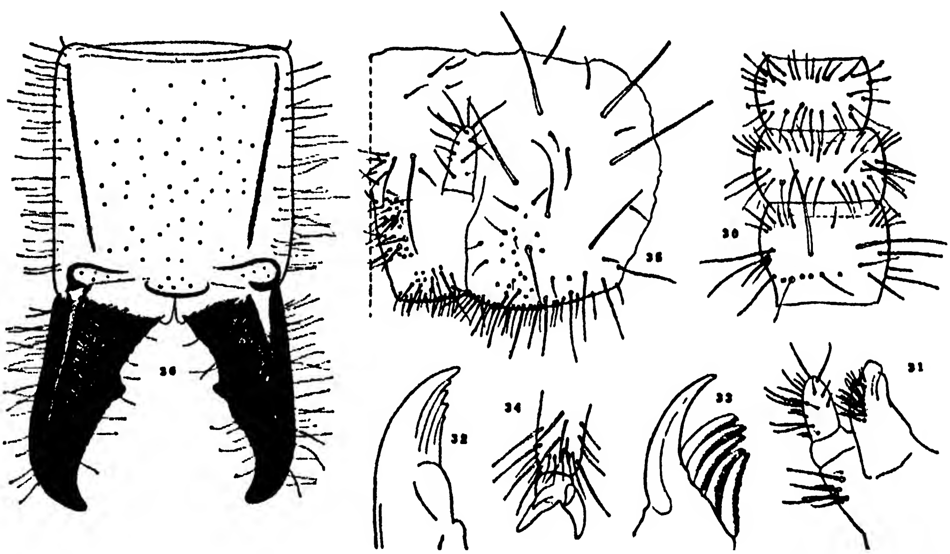
Heterojapyx novae-hollandiae Verh. Forceps.

was given to me by Mr. J. W. Evans. Two other specimens were also sent to me by Mr. Gourlay, labelled Nelson, New Zealand, February 22, 1933.

In all three examples the large praemedial tooth of the left arm of the forceps is not acute, as shown in Silvestri's figure, but broad and flattened (*cf.* fig.).

Heterojapyx evansi, n. sp.

Description.—Colour, deep honey yellow, segment X. almost reddish and forceps almost black. Head about as long as wide. Antennae 40-segmented, segments IV.-XIII. with 3-4 sensillary setae, these as long as the ordinary setae. Mandibles strong, with 5 teeth. Maxillae with internal and external lobes as figured. Abdomen: all tergites with their postero-lateral angles rounded. Subcoxal organ of first abdominal sternite as in other species. Legs short and robust, claws as figured. Stylets and vesicles normal. Segment X. slightly longer than wide, with distinct lateral carinae. Forceps very slightly shorter than segment X., with only one large praemedial tooth on each arm, before and after this tooth with a number of small rounded teeth or tubercles. Length of animal, 25-35 mm.



Figs. 30-36.
Heterojapyx evansi, n. sp.—30, segments II.-IV. of antennae; 31, external lobe of maxilla; 32, mandible; 33, internal lobe of maxilla; 34, foot; 35, right half of male genital organ showing appendage; 36, forceps and abdominal segment X.

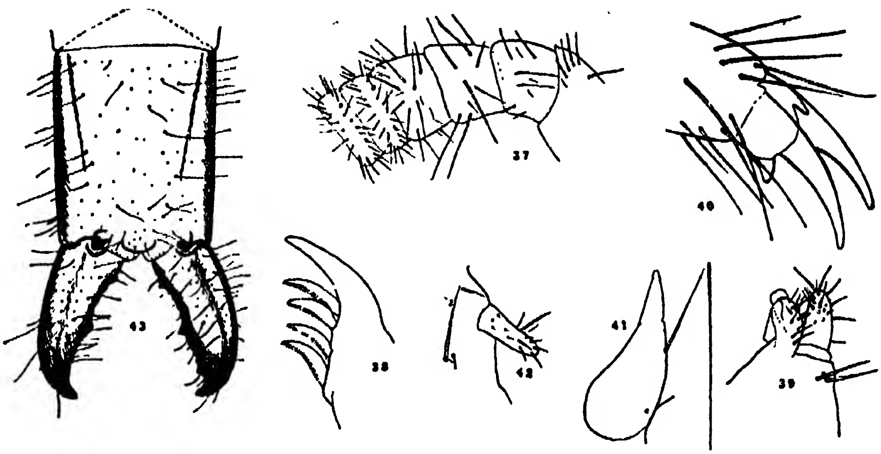
Type collected by Mr. J. W. Evans at Condor Creek, F. C. T., in October, 1929. Three other specimens are from Mount Kosciusko, F. C. T., in December, 1929, collected by Dr. R. J. Tillyard.

Remarks.—This species is very closely related to *H. victoriae* Silv., but the latter has two large teeth on each arm of the forceps.

Heterojapyx tambourinensis, n. sp.

Description.—Colour of a deep creamy yellow, segment X. almost reddish, forceps still darker. Head slightly longer than broad. Antennae 44-segmented with 3-4 sensory setae on segments IV.-XIII., these setae as long as the ordinary setae. Mandibles strong, with 5 teeth. Internal and external lobes of the maxillae, as figured. Labial palpi elongate 30 μ. by 90 μ. (*cf.* fig.). Legs short and robust, with claws as figured for preceding species. Abdomen with all tergites rounded at postero-lateral corners. Subcoxal organ of first sternite as in other species.

Stylets and vesicles normal. Segment X. of abdomen about as long again as wide and much longer than the forceps, with distinct lateral carinae. Forceps asymmetrical, left arm with two large teeth, the first sub-basal, the second praemedial; right arm with three large teeth, one sub-basal, one postmedial and one sub-apical. Length of animal, 28 mm.



Figs. 37-43.

Heterojapyx tambourinensis, n. sp.—37, basal antennal segments; 38, internal lobe of maxilla; 39, external lobe of maxilla; 40, foot; 41, stylet; 42, male genital appendage; 43, forceps and abdominal segment X.

The *type* is from Mount Tambourine, Queensland, collected by Mr. A. M. Lea; whilst the second specimen is from Sydney, also collected by Mr. Lea. In neither case is a date given. Both specimens were found in the South Australian Museum collections, mounted dry, on cards.

Genus PARAJAPYX Silv.

This genus, together with *Ectasjapyx* Silv., differs from all others in the entire absence of sensory setae on the antennae. The body is elongate and the exsertile vesicles are very large. The forceps are short and stout. In *Parajapyx*, segment IX. of the abdomen is shorter than either VIII. or X.; in *Ectasjapyx* these are equally long.

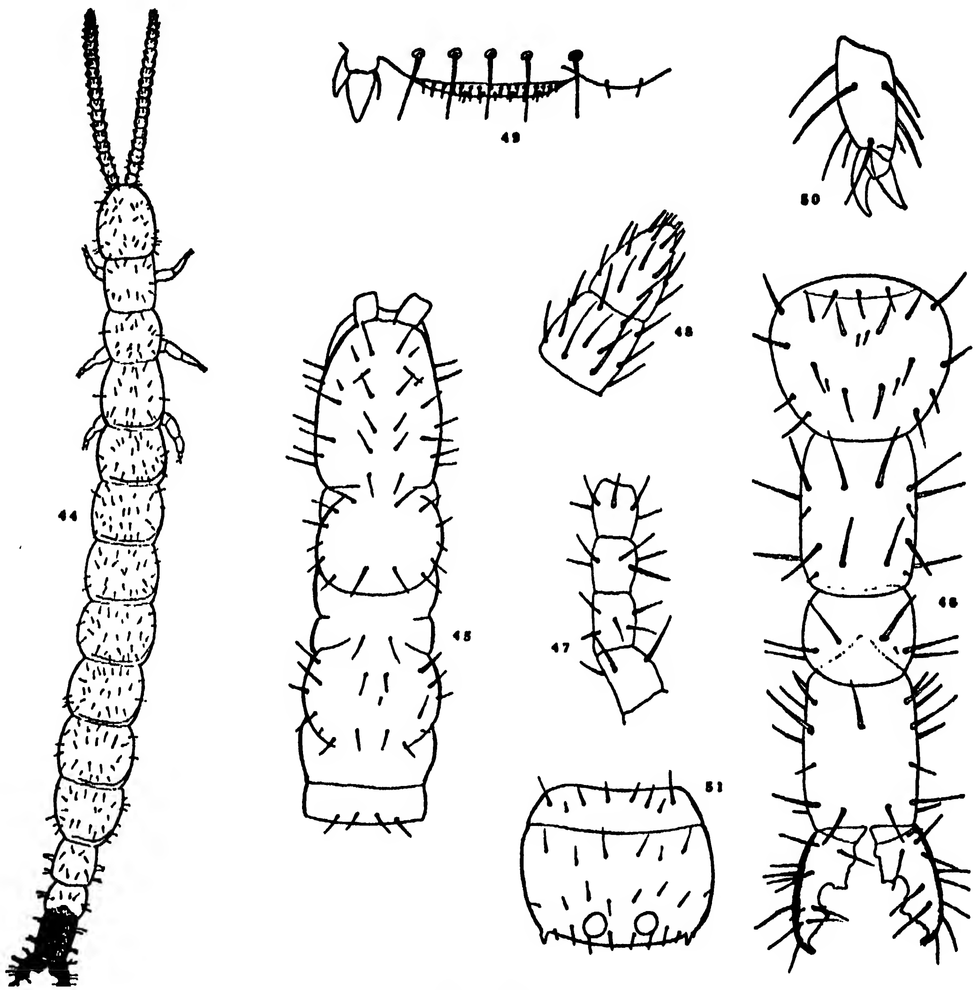
No species of this genus has previously been recorded from Australia, although *Parajapyx samoanus* was described by Silvestri from Samoa. The following new species is very distinct from *P. samoanus* Silv.

Parajapyx swani, n. sp.

Description.—Colour of a creamy yellow, only the forceps a little darker. Head with approximately 15 setae on each side above. Antennae 18-segmented, with the setae as figured. Thorax: pronotum with 7, meso- and metanotum with 10 setae on each side. Legs with tarsus shorter than praetarsus, median claw short, lateral claws subequal. Abdomen: first sternite with subcoxal organ, as figured. Stylets and exsertile vesicles normal. Segment VIII. about twice as long as IX. and as long as X., the last without lateral carinae. Forceps short and stout, symmetrical, with a very long indentation medially and a large tooth on each side of this indentation, the basal portion of the inner edge is almost straight

with a rather large rounded tooth proximally and then several small serrations, the distal portion of inner margin sinuate. Length of animal, 3-4 mm.

Syntypes.—Four specimens from Pinjarra, West Australia, September, 1931, collected by Mr. Swan; other examples from Kelmscott, West Australia, September, 1932 (H. W.), Glen Osmond, South Australia, in garden soil, October, 1929 (J. D.), April, 1932 (D. C. S.), and March, 1933 (H. W.).



Figs. 44-51.

Parajapyx swani, n. sp.—44, dorsal view of entire insect; 45, head and thorax I. and II. from above, more enlarged; 46, segments VII.-X. and forceps from above more enlarged; 47, basal antennal segments; 48, two apical antennal segments; 49, subcoxal organ on first abdominal sternite; 50, foot; 51, abdominal segment from below showing vesicles.

KEY TO THE AUSTRALIAN SPECIES OF *JAPYX*.

1. Segment X. of abdomen with distinct lateral carinae. 4
   Segment X. of abdomen without distinct carinae. 2
2. Forceps asymmetrical. 3.
   Forceps symmetrical. Antennae 24-segmented. Length, 7-8 mm. Tergites V. and VI. rounded, VII. strongly produced at postero-lateral corners. Each arm of forceps with one large praemedial tooth. *J. westraliense*, n. sp.

3. Antennae 32-segmented. Length of animal, 7-8 mm. Tergite V. slightly, VI. and VII. more produced at postero-lateral corners. Left arm of forceps with a large median tooth, and right arm with a large praemedian tooth. *J. froggatti* Silv.

Antennae 26-segmented. Length of animal, 5-6 mm. Tergites V., VI., and VII. rounded at postero-lateral corners. Left arm of forceps with postmedial tooth; right arm with large slightly postmedial tooth. *J. nichollsi*, n. sp.

4. Large species, 28 mm. Antennae 42-segmented. Forceps asymmetrical, left arm with large postmedian tooth and some fairly large proximal teeth; right arm with large praemedian tooth and a rather large tubercle proximally, from tooth to apex the margin is strongly concave. Tergite IV. slightly produced at the postero-lateral corners, V. strongly and acutely so, VI. and VII. more so, VIII. as in V. *J. glauerti*, n. sp.

Small species not exceeding about 15 mm. 5

5. Antennae 41-segmented. Length of animal, 15 mm. Tergite VI. scarcely produced at postero-lateral corners, VI. strongly produced. Forceps asymmetrical, left arms without large tooth and narrower than right arm; right arm with a large tooth at about one-third from base. *J. longiseta* Silv.

Antennae with fewer segments. 6

6. Antennae with 30 segments. Length of animal, 13 mm. Forceps asymmetrical, left arm with large postmedian tooth; right arm with large praemedian tooth. Tergite V. slightly, VI. slightly, and VII. somewhat more produced at postero-lateral corners. *J. leae* Silv.

Antennae with fewer segments. 7

7. Antennae with 28 segments. Length of animal, 7 mm. Forceps asymmetrical, left arm with large tooth beyond middle, right arm with large praemedian tooth. Tergite V. rounded, VI. shortly, and VII. largely produced at postero-lateral corners. *J. michaelseni* Silv.

Antennae with 26 segments. 8

8. Length of animal, 8 mm. Forceps asymmetrical, left arm with large postmedial tooth, right arm with large praemedian tooth. Tergite V. rounded, VI. slightly, and VII. more produced at postero-lateral corners. *J. tillyardi* Silv.

Length of animal, 8 mm. Forceps asymmetrical, left arm with strongly sinuate inner margin without large tooth, right arm with large submedian tooth. Tergite V. rounded, VI. slightly, and VII. more produced at postero-lateral corners. *J. mjöbergi* Silv.

KEY TO THE AUSTRALASIAN SPECIES OF *HETEROJAPYX*.

1. Forceps symmetrical. 2

Forceps asymmetrical. 3

2. Forceps with only a large praemedian tooth on each arm. Antennae 40-segmented. Length of animal, 25 mm. *H. evansi*, n. sp.

Forceps with two large teeth on each arm, one praemedial and one postmedial. Antennae 39-segmented. Length of animal, 38 mm. *H. victoriae* Silv

3. Left arm of forceps with a fairly large tooth near the base. 4

Left arm of forceps with only a praemedian large tooth. Antennae 39-segmented. *H. novae-hollandiae* Verh.

4. Second large tooth of left arm of forceps median in position; right arm with a sub-basal, a slightly postmedial and a subapical large tooth. Antennae 44-segmented. Length of animal, 28 mm. *H. tambourinensis*, n. sp.

Second large tooth of left arm of forceps praemedian in position; right arm with 4 large teeth, one sub-basal, one at one-fourth from base, one postmedial, and one subapical. Antennae? Length of animal, 30-50 mm. *H. gallardi* Till.

BIBLIOGRAPHY.

1. SILVESTRI, F. 1901—Materiali per lo studio dei Tisanuri, ii. Specie di *Japyx* conservate nello mia collezione. *Boll. Soc. ent. ital.*, **vol. xxx.**, pp. 212-223.
2. „ „ 1904—Thysanura in "Fauna Hawaiiensis," **vol. iii.**, pp. 295-7.
3. „ „ 1908—Thysanura, Japygidae, in "Die Fauna Südwest-Australiens," **vol. ii.**, pp. 47-68.
4. „ „ 1910—Materiali per lo studio dei Tisanuri, xv., Nova specie di Heterojapyx dell' Australia. *Boll. Lab. Zool.*, Portici., **vol. v.**, pp. 97-99.
5. „ „ 1928—Results of Dr. E. Mjöberg's Swedish Scientific Expeditions to Australia, 1910-13, xlviii., Thysanura, Japygidae. *Arkiv. f. Zool.*, Bd., 20A, No. 9, pp. 1-4.
6. „ „ 1930—Contribuzione all conoscenza degli Japygidae (Thysanura) della regione Australiana. *Boll. Lab. Zool.*, Portici, **vol. xxiii.**, pp. 210-226.
7. TILLYARD, R. J. 1924—Primitive wingless insects, pt. i., The Silver Fish, Bristlestails and allies. *New Zealand Jour. Sci. & Tech.*, **vol. vii.**,
8. „ „ 1926—In "Insects of Australia and New Zealand," Sydney.

SINGLE VALUE CLIMATIC FACTORS.

By J. A. Prescott,
Waite Agricultural Research Institute, The University of Adelaide.

[Read May 10, 1934.]

In the study of the relationship between climatic conditions and the geographical distribution of plants and animals and of soils, numerous attempts have been made to secure correlations between such distributions and single value functions of the weather which have been deemed most appropriate or most efficient. Mean annual values for temperature and for rainfall are the most familiar examples of such single values, but these are not in themselves generally considered by most workers to be efficient measures of climatic conditions when anything more than a limited area is under consideration.

It is the purpose of the present paper to enumerate and examine, so far as the original literature has been available, the various attempts that have been made in this direction, and to discuss their mutual relationships and probable relative efficiencies for the purpose under consideration. Only those single values relating to moisture conditions or rainfall efficiency will be considered.

The essential principle of all the methods adopted has been to correct for the decreasing efficiency of rainfall under rising temperature by means of a function involving both rainfall and temperature. In another series this correction is applied through an estimate of the evaporation either directly from evaporimeters or through some function of the water vapour pressure of the atmosphere related to evaporation which could be determined from observations on temperature and relative humidity.

Precipitation-temperature Ratios.

The first attempt in this direction is that of Lang (1915), who was primarily concerned with possible temperature and rainfall limits of soil zones having a recognised geographical distribution. The Lang factor $\frac{P}{T}$ (where P is expressed in millimetres and T in degrees centigrade) has not been extensively applied, its place having been taken by other factors with temperatures at different zero points.

In the "index of aridity" of de Martonne (1926), the zero point is taken at -10°C., which was determined by de Martonne and Aufrère (1925) as being most in accord with the observed proportional distribution of areas of internal drainage over the earth's surface. This index $\frac{P}{T + 10}$ has been used by de Martonne himself in defining the climatic limits of deserts, prairies, and forests, and has been used in relation to Australia by Andrews and Maze (1933), who observe that this index gives a satisfactory general impression of the conditions which prevail. Perrin (1931) and Andrews and Maze (1933) have further discussed the monthly values of this index, the former in relation to forest types and the latter in relation to aridity. Perrin observes that the factor does not apply well to cool zones owing to high values in the cold months, with an infinitely high value at -10°C. Andrews and Maze assume that a monthly index of 1 is a significant indication of the condition of aridity, and plot the number of months of the year with an arid period, in itself a new single value. This method of enumerating those months of the year having some characteristic climatic ratio is of some

considerable promise and has been further applied by Davidson (1933, 1934), who has determined the months of the year in which rainfall exceeds the estimated evaporation.

Emberger (1930) further investigated the application of the factor of de Martonne, particularly in relation to Mediterranean climates, and found a more satisfactory ratio in the expression,

$$\frac{100}{2} \quad \frac{P}{\left(\frac{M+m}{2}\right)(M-m)}$$

where M = the mean maximum temperature of the warmest month and m the mean minimum temperature of the coldest month, the expression M — m serving, therefore, as an index of continentality, and, according to Emberger, of evaporation

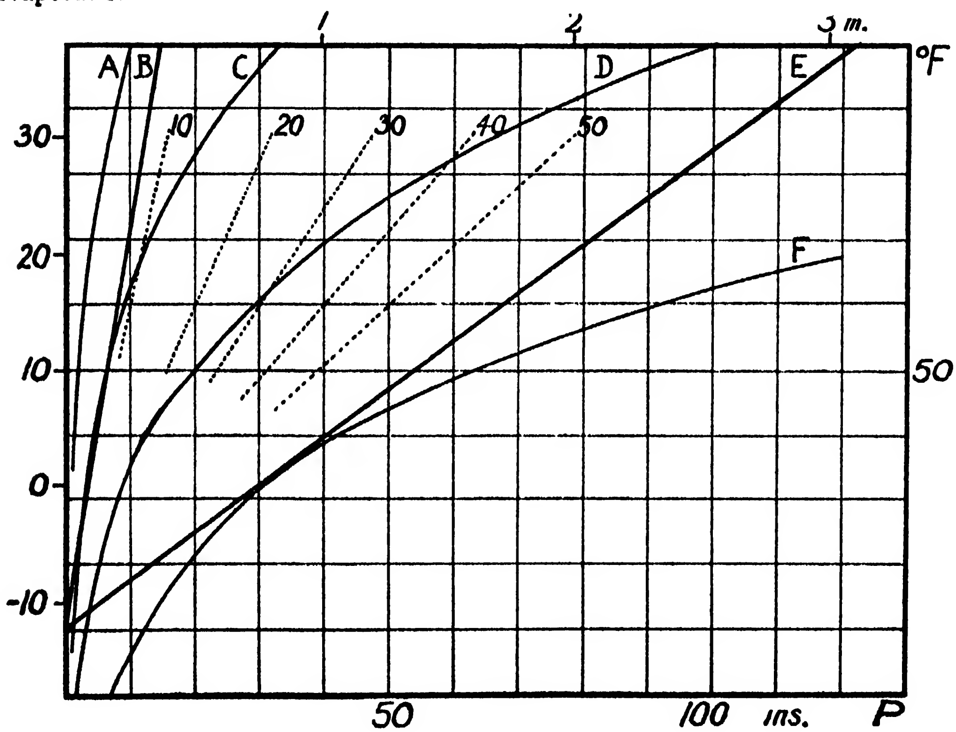


Fig. 1.

Showing the relationship between temperature and precipitation for constant precipitation-evaporation ratios.

P/E = 0·1.
- A for 80% relative humidity.
- B Thornthwaite's value.
- C for 30% relative humidity.

P/E = 1·0.
- D for 80% relative humidity.
- E Thornthwaite's value.
- F for 30% relative humidity.

The broken lines indicate indices of aridity according to de Martonne's formula $\frac{P}{T+10}$.

The ratio E = 260 s.d. has been assumed in curves A, C, E, and F.

In seeking for a similar relationship with respect to the distribution of soil types in Quebec, McKibbin (1933) found it necessary to disregard conditions in

the winter five months where the ground was frozen, and to measure both rainfall and temperature as monthly means from selected base values, 2 inches in the case of rainfall and 52°F. in the case of temperature. McKibbin's ratio, therefore, becomes $\frac{P-2}{T-52}$ expressed in inches of rain and in degrees Fahrenheit, considering only the growing season of seven months. The base value 2 for rainfall is selected from the lowest average monthly rainfall recorded for any observation point within the area under consideration, and similarly the lowest mean monthly temperature is selected as the temperature base.

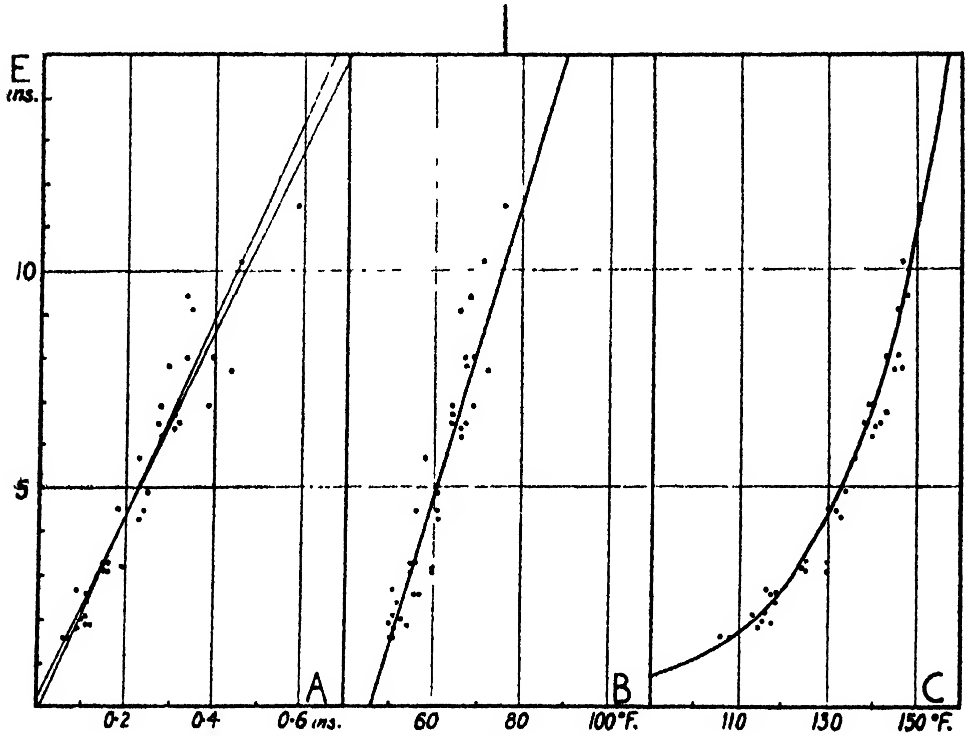


Fig. 2.

Showing the relationship between the evaporation from a free water surface at the Waite Institute for 36 consecutive months, and A, saturation deficiency; B, mean temperature; and C, solar maximum temperature.

In 2A, the two regression lines relating E and s.d. have been drawn. In 2B, the point of intersection with the temperature axis is 46°F. corresponding to the mean dew point. The curve in 2C is calculated from the relationship log E = k.T, and the curve illustrated fits the mean monthly data for the capital cities reasonably well.

Precipitation-evaporation Ratios.

All climatic factors involving estimates of evaporation go back to the work of Transeau (1905) who suggests the factor P/E, utilizing for this purpose the evaporation data collected by Russell (1888) during the season 1887-1888. This ratio is ideal in many ways in that the units of rainfall and evaporation are the same, namely inches or centimetres of water, and was regarded by Livingstone and Shreve (1921) "as the nearest approach as yet possible towards an ideal index of the external moisture-relation of plants."

This opinion of Livingstone and Shreve led Szymkiewicz to a fuller study of the subject, which resulted in an extended series of papers in the Records of the Botanical Society of Poland extending from 1923 to 1930. Szymkiewicz pointed out that in accordance with Dalton's Law (1798) the intensity of evaporation is proportional to the difference between the vapour tension at the evaporating surface and that of the surrounding air, or in other words, was principally dependent on the vapour tension deficit (deficit hygrometrique, Sättingungs-deficit), and that the use of this climatic constant was more satisfactory than evaporation records insofar as these were dependent on the form of the evaporimeter as well as on humidity, atmospheric pressure, wind velocity and insolation. The European literature on evaporation is extensively reviewed in this series of

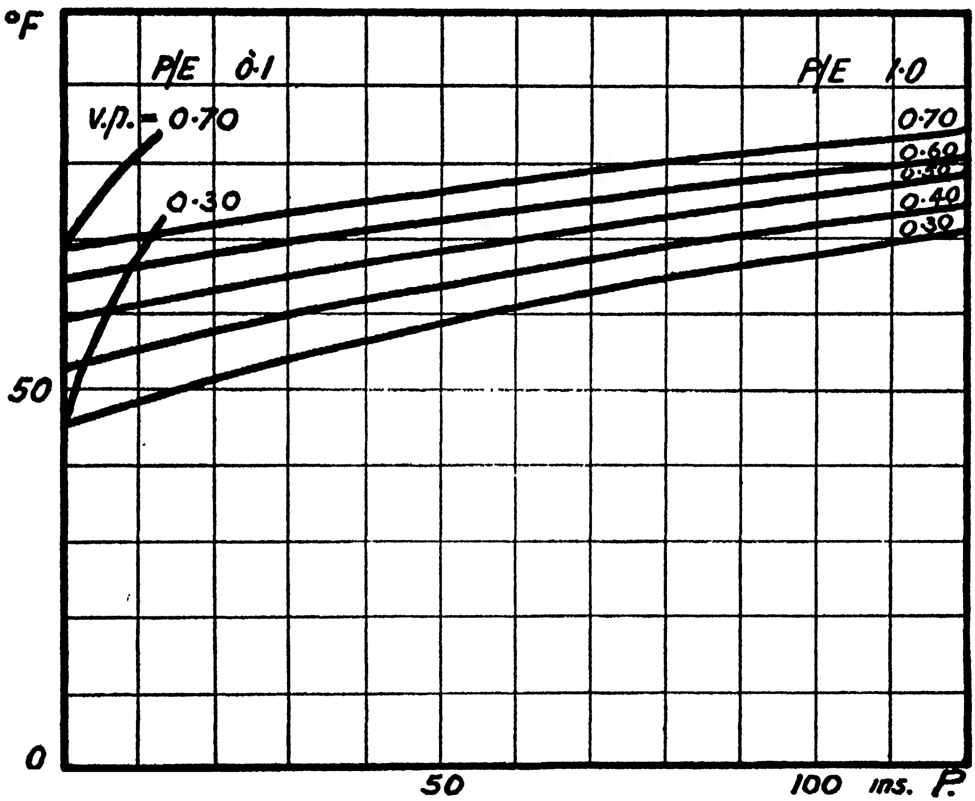


Fig. 3.

Showing the relationship between temperature and precipitation for constant precipitation evaporation ratios of 0·1 and 1·0, the water vapour pressure of the atmosphere remaining constant at the given values ranging from 0·30 to 0·70.

papers, and Szymkiewicz develops the concept of index of evaporation to replace actual evaporimeter measurements. In one of his first papers (1923) the index of evaporation is

$$i = \text{s.d.} \frac{(273 + t)^2}{273^2} \cdot \frac{760}{P - p},$$

where s.d. = vapour pressure deficit.
P = atmospheric pressure.
p = water vapour pressure.

This expression allows for the effect of temperature in raising the humidity at the surface of the evaporimeter. In a fifth paper (1925), starting from the work of Stefan (1871, 1874), he further considers the effect of diffusion on the rate of evaporation; his new index of evaporation becomes

$$i = \text{s.d.}\,\frac{273 + t}{273}\cdot\frac{760}{P - p}$$

In the calculation of saturation deficit he suggests that this should be measured at the maximum temperature for each day, the mean value for each day being

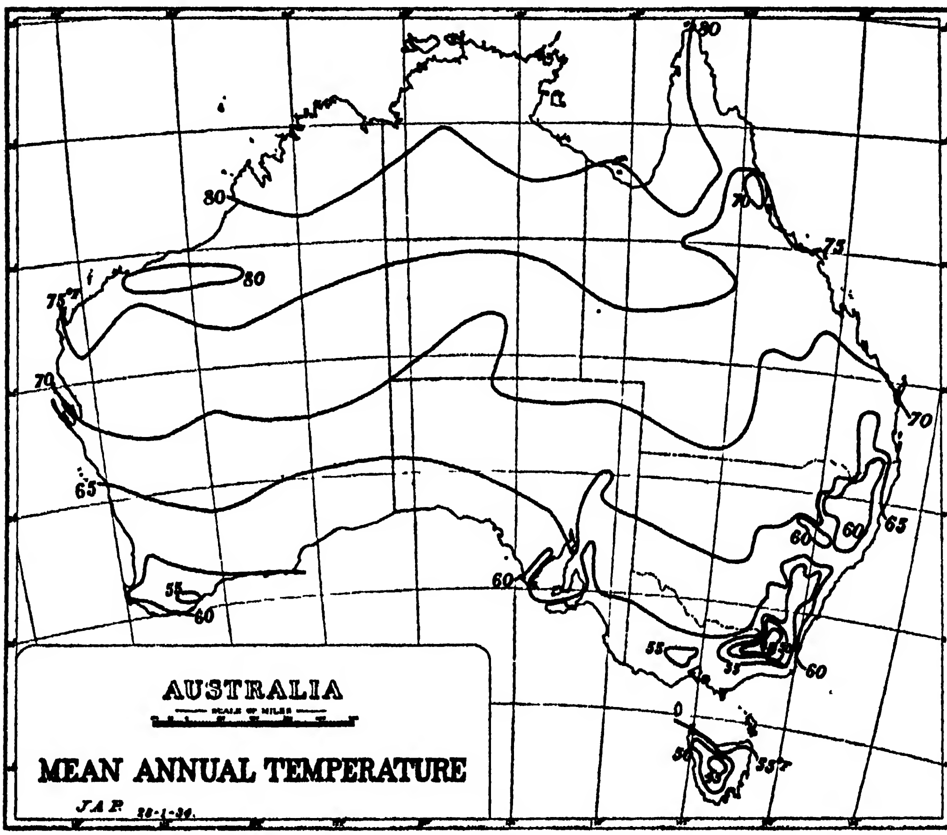


Fig. 4.

very nearly half that observed at the maximum temperature. As an annual index of evaporation he takes the sum of these mean monthly maxima and develops the Hygrometric coefficient $Q = \frac{P \text{ (in mm.)}}{I \text{ (in mm. Hg.)}}$ where $I = \Sigma i$. At the limit for steppe formation, $Q = 5$.

On the publication of de Martonne's paper (1926), Szymkiewicz returns to the question and points out that evaporation is not a linear function of temperature but, if anything, an exponential function, and that in any case only reasonable

agreement between his index of evaporation and this exponential function is to be observed.

Meyer (1926), in discussing the work of Szymkiewicz, called attention to the unduly complex nature of the index of evaporation of this author and recommended the simple ratio of rainfall to saturation deficiency P/s.d. In the original paper are given the values of this ratio both for the year and for the frost free period for 505 stations in Europe, North Africa and West Asia, while Jenny (1929) subsequently covered the United States in a similar manner. Meyer recognised that the ratio was inadequate in so far as it omitted to take account of atmospheric pressure and of wind velocity on evaporation, nor could it take into consideration the distribution of the rain, and such features as sunshine, fog or

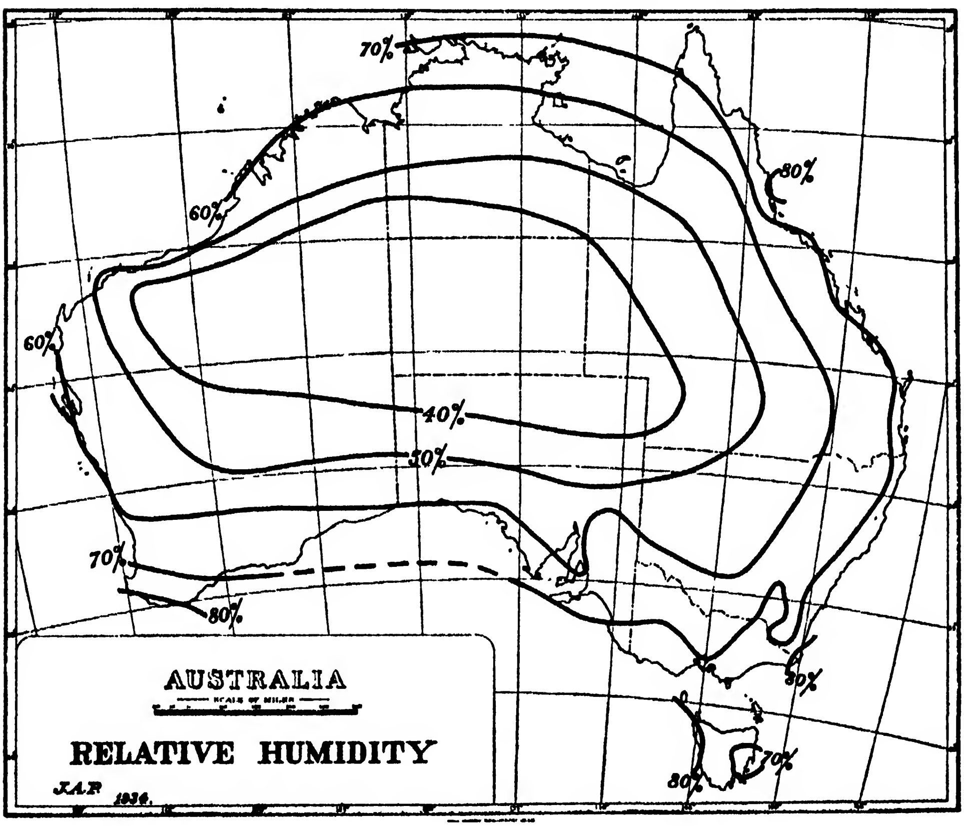


Fig. 5.

frost. In such a ratio one could only expect a clue to and not a complete expression of the connection between climate and soil.(1)

Thornthwaite (1931) has recently approached the subject again from the point of view of securing an expression for the P/E ratio, which could be obtained from a consideration of rainfall and temperature exclusively and a series of relationships between various monthly ratios of rainfall, evaporation and the temperature records for twenty-one stations in the western United States for the

(1) In the absence of access to the original paper, I am indebted to the Imperial Bureau of Soil Science for translated excerpts.

months April to September, inclusive. His analysis, which takes no account of relative humidity, results in an empirical relationship

$$\frac{P}{E} = 11{\cdot}5\left(\frac{P}{T-10}\right)^{\frac{10}{9}}$$

where P is in inches and T in degrees Fahrenheit. For the annual index, ten times the sum of the twelve monthly P/E ratios is taken.

Where values for relative humidity are available, this new relationship must be considered to be much inferior to the Meyer ratio.

In fig. 1 an attempt has been made graphically to depict the relationship found by Thornthwaite in relation to the ratio of de Martonne and to the actual precipitation evaporation ratios calculated from temperature and humidity considerations. The zero point $+10°$F. is so close to de Martonne's ($+14°$F. $= -10°$C.) that the expression $\frac{P}{T-10}$ in the above equation is practically identical with the $\frac{P}{T+10}$ of de Martonne. The lines B and E represent Thornthwaite's values for P/E ratios of 0·1 and of 1·0, respectively, while the

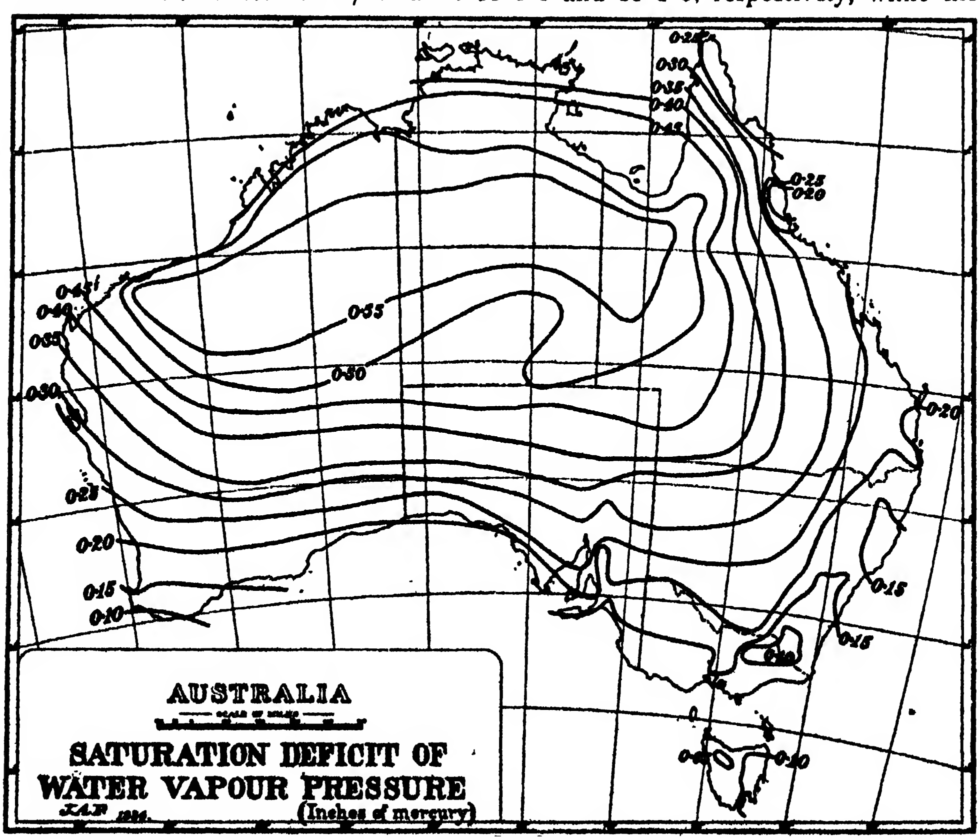


Fig. 6.

lines A and C, D and F, represent the corresponding theoretical lines for these ratios for relative humidities of 30% and 80%, the Australian limits for the mean

annual values. The broken lines marked 10 to 50, respectively, are the de Martonne ratios.

Saturation Deficiency as an Index of Evaporation.

As has already been pointed out, the fact that the evaporation from the surface of a liquid is proportional to the deficiency from saturation of the vapour pressure above that liquid was first enunciated by Dalton, and may be regarded as an established physical law.

Wherever the mean saturation deficiency can be calculated as a meteorological constant, it is obviously much more efficient than temperature alone as an index of the evaporating power of the atmosphere, and should be utilized whenever possible. The two observations required are temperature and relative humidity, and it is usually the doubt with regard to the accuracy of the latter value that has made most workers hesitate to calculate the water vapour pressure of the atmosphere or the saturation deficit of this vapour pressure. It is generally accepted that the mean temperature as represented by $\frac{\text{Maximum} + \text{Minimum}}{2}$ is a satisfactory measure of temperature so far as annual and monthly values are concerned. The Australian meteorological service has chosen the 9.0 a.m. reading of relative humidity as representing the mean for the day, and while this is not always true so far as individual days are concerned, it is very nearly true when a period even so short as one week is considered.

In order to confirm this assumption, five weeks were taken at random during 1933 and the hourly values of relative humidity taken from the hygrograph records. The comparison between the values at 9.0 a.m. and the mean values is given in Table I., and a satisfactory agreement is to be noted.

Table I.

Comparison of mean hourly values for relative humidity with those for 9.0 a.m. (Hygrograph readings, Waite Institute).

Week Ending	9 a.m. Readings, %.	Mean Hourly Readings, %.
February 6, 1933 - - - -	57·3	56·3
April 24, 1933 - - - -	82·1	81·2
July 17, 1933 - - - -	88·0	92·4
October 23, 1933 - - - -	52·1	53·7
January 1, 1934 - - - -	48·7	54·8
Mean - -	65·6	67·7

The values for relative humidity at Australian stations recently published can, therefore, be used with confidence as satisfactory estimates for the calculation of saturation deficiency.

At a number of Australian stations, in recent years, records of evaporation from a free water surface have been obtained, using tank evaporimeters three feet in diameter. The records from such tanks have not yet been collected and critically co-ordinated, but the working data collected by the author from various sources are worthy of discussion at the present stage. Apart from the values published in the Commonwealth Year Book, reports of the irrigation authorities in Queensland and New South Wales are the principal sources of information.

These annual evaporimeter records and relevant data are given in Table II.

TABLE II.

Mean annual evaporation from a free water surface at Australian stations.

Station.	Evaporation (E) (Inches).	Mean Temperature °F.	Mean Relative Humidity 9 a.m. %.	Saturation Deficit (s.d.) Inches of Mercury.	E / s.d.
QUEENSLAND.					
Brisbane	56	68·9	68	0·22	254
Blackall	86	72·4	50	0·40	215
Charleville	70	70·0	48	0·38	185
Home Hill	72	74·1	67	0·28	257
Warwick	56	63·5	66	0·20	280
Rockhampton	52	73·1	67	0·28	186
St. George	71	68·9	56	0·31	229
Winton	98	75·5	45	0·50	196
Boulia	123	75·4	38	0·55	223
NEW SOUTH WALES and F.C.T.					
Sydney	39	63·2	70	0·17	229
Griffith	58	62·5	63	0·21	276
Leeton	51	62·2	61	0·21	242
Burrinjack	36	58·0	69	0·15	240
Wentworth	62	63·8	63	0·21	296
Dubbo	66	63·7	64	0·21	314
Canberra	46	55·8	69	0·14	328
VICTORIA and TASMANIA.					
Melbourne	39	58·4	68	0·15	260
Rutherglen	51	60·1	67	0·17	301
Merbein	67	62·0	67	0·19	352
Hobart	32	54·3	68	0·13	246
SOUTH AUSTRALIA and N.T.					
Adelaide	55	63·0	53	0·27	204
Waite Institute	62	61·3	66	0·19	327
Alice Springs	94	69·6	37	0·47	201
WESTERN AUSTRALIA.					
Perth	66	64·2	63	0·21	314
Kalgoorlie	88	65·9	57	0·28	314
Coolgardie	84	64·5	54	0·28	300
				Mean	259

The improvement in the relationship obtained by allowing for wind velocity has already been indicated by Davidson (1933).

In plotting these data, the most satisfactory correlation on inspection is that between evaporation and saturation deficit; that between evaporation and temperature is not so satisfactory.

THE RELATIONSHIP BETWEEN EVAPORATION AND METEOROLOGICAL FACTORS AT THE WAITE INSTITUTE.

For the thirty-six consecutive months, January, 1931, to December, 1933, corresponding to a period when wind velocity records were first available, the

relationship between climatic factors and the evaporation from a free water surface at the Waite Institute has been statistically investigated. The evaporimeter is the standard Australian tank, three feet in diameter. In fig. 2 are plotted the relationship between the total monthly evaporation and the mean saturation deficiency, mean temperature and mean solar maximum temperature. The correlation coefficient between evaporation and saturation deficiency is 0·96, and the corresponding regression lines are given in the diagram. Between mean temperature and evaporation the correlation is from inspection if anything rather higher, evaporation reaching its zero point at 46°F., corresponding to the dew point of the average water vapour pressure during this period, of 0·31 inches. The range of vapour pressure was from 0·24 to 0·37, corresponding to dew points of 39°F. and 51°F.

In the case of solar maximum temperature the correlation is even greater, the logarithm of the evaporation bearing a linear relationship to the solar maximum temperature which tends to be high in relation to the mean temperature when the vapour pressure is low.

The wind factor varies in these records from 2·1 to 6·0 miles per hour with a mean at 3·9. The range is rather small and the wind velocity is higher in winter than in summer, so that in all the statistical significance is less satisfactory.

The statistical examination of the records yields the following correlations:—

Evaporation to saturation deficiency - -	0·958
Evaporation to wind velocity - - -	0·746
Wind velocity to saturation deficiency - -	0·657
Evaporation to saturation deficiency (after eliminating wind) - - - -	0·932
Evaporation to saturation deficiency x wind -	0·966

The standard equation relating evaporation to wind velocity is of the form:—

$$E = (k - lB)\ (m + nW)\ \text{s.d.}$$

where E = evaporation for 24 hours,
B = barometric pressure,
W = wind velocity in miles per hour,
s.d. = saturation deficiency,
and k, l, m, n are constants.

For conditions corresponding to those at the Waite Institute, American workers have usually adopted the formula $E = (0{\cdot}5 + 0{\cdot}05W)$ s.d., which at the mean wind velocity value of 3·9 would give $E = 0{\cdot}69$ s.d., whereas the regression equation calculated from the above data gives the practically identical value, $E = 0{\cdot}0085 + 0{\cdot}68$ s.d.

The regression equation of this form calculated from the above 36 values at the Waite Institute is:—

$$E = 0{\cdot}84 + (7{\cdot}66 + 2{\cdot}45W)\ \text{s.d. for the monthly values,}$$
$$\text{or } E = 0{\cdot}03 + (0{\cdot}25 + 0{\cdot}081W)\ \text{s.d. for the daily values,}$$

with a multiple correlation coefficient of 0·969.

The equation developed experimentally by Rohwer (1931) is $E = (0{\cdot}44 + 0{\cdot}118W)$ s.d., where the wind velocity and saturation deficiency are both measured at the surface of the water. This wind velocity is approximately 0·4 that of the standard anemometer reading at 30 feet above ground level.

It is evident that before a satisfactory formula can be developed for the standard Australian evaporimeter further work will be required.

Fig. 2B brings out an important fact which is generally overlooked in these discussions, that the real zero point for temperature in relation to evaporation is not the — 10°C. of de Martonne nor the — 10°F. of Thornthwaite, but the dew-point. This value will, of course, vary with locality, and from time to time. While the relative humidity varies enormously during the day, as a result of temperature changes, it is rarely realized how relatively constant remains the vapour pressure, and that only for localities with equal mean vapour pressures can an approximately linear relationship hold between evaporation and temperature. In fig. 3 have been demonstrated, in the same manner as in fig. 1, the lines

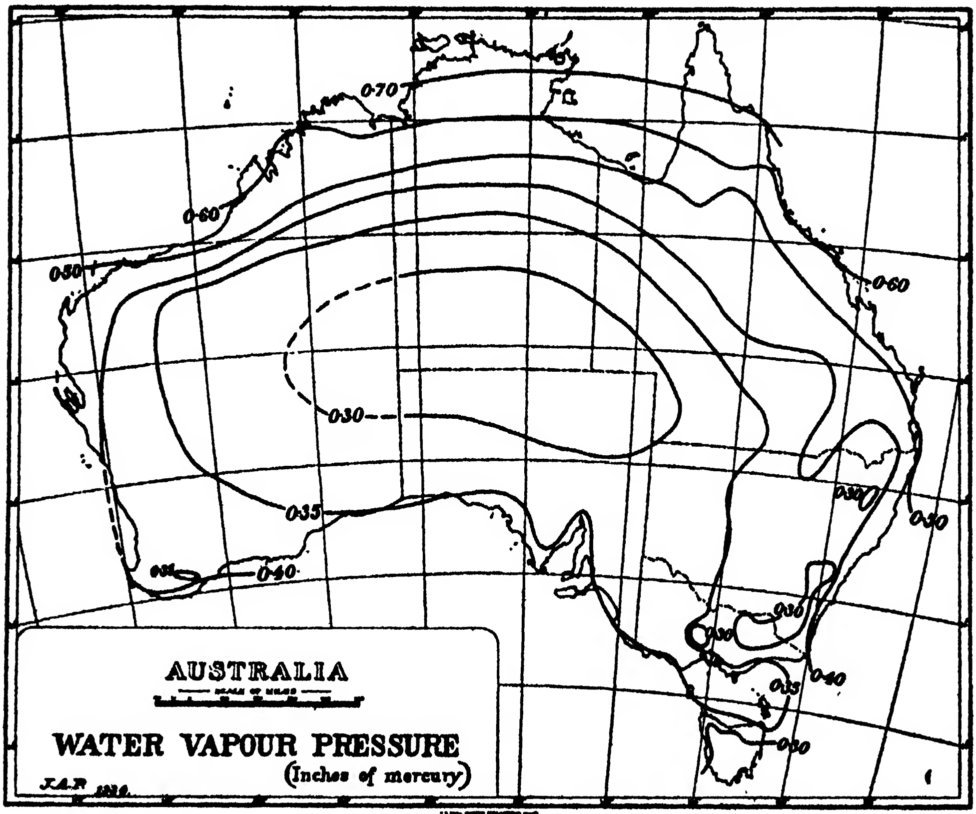


Fig. 7.

relating temperature and precipitation in cases where P/E = 0·1 and 1·0, respectively, and for vapour pressures corresponding to the Australian limits of 0·30 to 0·70 inches of mercury. Within limits these curves approximate to straight lines and represent the ideal relationship which de Martonne and his successors have been striving to attain. An examination of the map of Australia showing vapour pressure (fig. 7) shows that a large area of the continent most subject to study from the southern centres has a mean vapour pressure between 0·30 and 0·40, so that such a simple relationship might readily be established, but that once north of the Tropic of Capricorn this value rises rapidly and that independent relationships would be required. The approximately parallel character of these lines recalls Crowther's leaching factor (1930), in which a rise of 1°C. must be compensated for by 3·3 cms. of rain in order to maintain constant leaching conditions. This would correspond in the above diagram to a P/E ratio of approximately 0·2.

The Relationship between Single Value Climatic Factors and Vegetation.

The principal purpose of the evaluation of single value factors is naturally to give some quantitative expression to the degrees of humidity and aridity which have received qualitative recognition.

The relationships that have been determined can best be observed by reference to the following table:—

Table III.

Lang Factor P/T.		de Martonne P/T+10.		Thornthwaite P/E.		
Soil Zone.	Limits of Index.	Vegetation Zone.	Limits of Index.	Vegetation Zone.	Limits of Index.	Calculated to I
Podsols	160+		40	Rain Forest	128+	277
Black Earths	100—160	Forests		Forest	64—128	177
Brown and Red Soils	40—100		30	Grassland	32—64	89—177
Semi-desert and Steppe Soils	0—40	Prairies	10	Steppe	16—32	44—177 ?
		True Deserts	below 5	Desert	0—16	0—44

* Assuming E = 260 s.d.

Meyer P/s.d.		P/s.d.	
Soil Zone.	Limits of Index.‡	Vegetation Zone	Observed Limits for Australia.
Podsols	400—1,000	High Moor	500—1,000
Brown Forest Soils	300—450	Forests	200—1,000
Prairie Soils	260—350	Savannah Woodlands	50—200
Black Earths	130—250	Arid Grassland	40—50
Grey and Brown Soils	30—170	Desert Steppe	18—40
Desert Soils	0—30	Desert	0—18

‡ Includes also Jenny's estimates.

In the case of Australia, the values for actual rainfall and saturation deficit were actually entered along the boundaries between the vegetation association depicted on the author's vegetation map of Australia (1931). In practically all cases a reasonably satisfactory linear relationship between precipitation and saturation deficiency was observed along the whole boundary between any two given associations. This is further brought out by an inspection of the map illustrating the Meyer ratio (fig. 8). The Meyer ratio, or an alternative function including rainfall and saturation deficiency, therefore appears to offer an efficient measure of rainfall-evaporation relationships and to be worthy of further investigation.

Climatic Constants for Australia.

In view of the recent publication[2] of meteorological data for certain Australian localities, the opportunity has been taken to revise the various maps that have been published by the author in connection with previous studies (1931), and these are given in figs. 4 to 8. The principle adopted has been to enter at

[2] C.S.I.R. Pamphlet 42, 1933.

each locality on a blank map of Australia the relevant climatic constant. For temperature in each area the quantitative relationship between height above sea level and temperature was determined, so as to obtain satisfactory interpolations. In the case of saturation deficiency and vapour pressure, these were calculated for each station and entered on a map on which the temperature and relative humidity lines had also been projected. A similar method was employed in the case of the Meyer ratio. In view of the fact that further data for Australia are not likely to be available for some considerable time, the charts are presented in the hope that they may be of some service to other students of these problems.

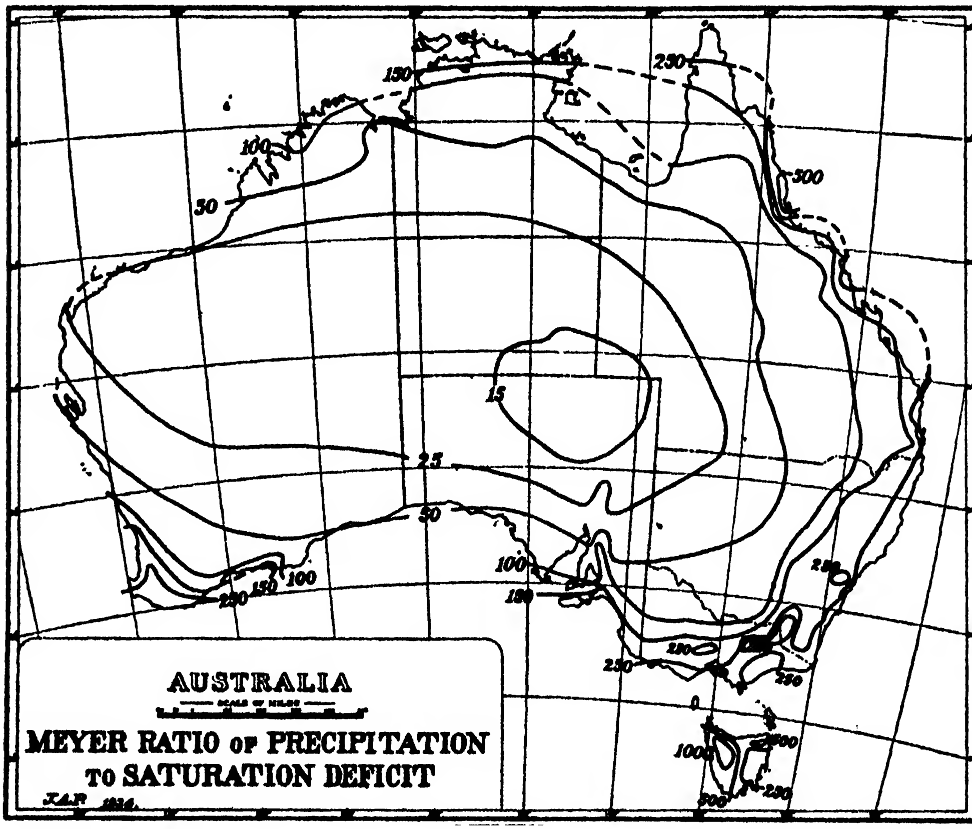


Fig. 8.

References.

1. Andrews, J., and Maze, W. H.—Proc. Linn. Soc., N.S.W., vol. lviii., p. 105. 1933.
2. Crowther, E. M.—Proc. Roy. Soc. B., vol. cvii., p. 1. 1930.
3. Dalton, J.—Mem. Manchester Lit. & Phil. Soc., vol. v., p. 535. 1798.
4. Davidson, J.—Aust. J. Expt. Viol., vol. xi.,, p. 59., 1933. Trans. Roy. Soc. S. Aust., vol. lviii., pp. 58-61. 1934.
5. De Martonne, E.—Comptes Rendus, vol. clxxxii., p, 1,395. 1926.
6. De Martonne, E., and Aufrère, L.—Comptes Rendus, vol. clxxx., p. 939. 1925.
7. Emberger, L.—Comptes Rendus, vol. cxci., p. 389. 1930.

8. JENNY, H.—Soil Research, **vol. i.**, p. 139. 1929.

9. LANG, R.—Int. Mitt. Bodenkunde, **vol. v.**, p. 312. 1915.

10. LIVINGSTONE, E. B., and SHREVE, F.—Carnegie Inst. Publ., No. 284. 1921.

11. MCKIBBIN, R. R.—Sci. Agric., **vol. xiii.**, p. 413. 1933.

12. MEYER, A. Chem. der Erde, p. 209. 1926.

13. PERRIN, H.—Comptes Rendus, **vol. cxcii.**, p. 1,271. 1931.

14. PRESCOTT, J. A.—C.S.I.R., Bull. 52., 1931. Trans. Roy. Soc. S. Aust., **vol. lv.**, p. 65, 1931.

15. RUSSELL, T.—U.S. Monthly Weather Rev., **vol. xvi.**, p. 235. 1888.

16. STEFAN, I.—Sitz. ber. Akad., Wien, **vol. lxiii.** (2), p. 63., 1871; **vol. lxviii.** (2), p. 385, 1874.

17. SZYMKIEWICZ, D. — Acta Societatis Botanicorum Poloniae, 1923-1930: **Vol. i.**, p. 8, 1923; **vol. i.**, p. 244, 1923; **vol. ii.**, p. 130, 1924; **vol. ii.**, p. 239, 1925; **vol. iii.**, p. 115, 1925; **vol. iv.**, p. 55, 1926; **vol. vi.**, p. 93, 1929.

18. TRANSEAU, E. N.—Amer. Nat., **vol. xxxix.**, p. 875. 1905.

AUSTRALITES, PART I.

CLASSIFICATION OF THE W. H. C. SHAW COLLECTION

By CHARLES FENNER, D.Sc., University of Adelaide.

[Read July 12, 1934.]

I. INTRODUCTION.

Arising from conversations and correspondence with Dr. L. J. Spencer, of the British Museum, in 1931-2, the writer in 1933-4 undertook the compilation of a census of all the australites in accessible collections, with an analysis of the chief form types, together with a distribution map of recorded occurrences. This work is being continued.

During the course of the investigation Professor de Courcy Clarke, of the University of Western Australia, suggested communication with Mr. W. H C. Shaw, of Perth, who had been a collector of australites for many years. Mr. Shaw, when approached, generously offered to forward his collection to Adelaide for counting and classification. This was done, and the present paper is the outcome.

This paper represents the first systematic attempt to classify and describe the forms and surface features of the whole of a considerable collection of these mysterious and interesting objects. The Shaw collection contains 3,920 separate pieces. Although but a small proportion are perfect in form, with flanges, etc., 1,993 of them are sufficiently complete to be regarded as "whole" specimens.

Of the 1,927 broken specimens, 1,483 are readily identifiable and able to be classified; the forms and surface features of many of the fragments are as informative as some of the whole specimens. In the collection there are also included 344 nondescript fragments, many of which may yet prove to have special interest. From the point of view of numbers, this collection is comparable with the total number of specimens at present preserved in the museum collections of Australia.

For nearly 100 years the scientific world has shown a notable interest in tektites generally, and, since 1851, in australites in particular. There has been a steady output of papers, with special bursts of interest around the years 1898, 1908-9, and 1914; there has been a further notable evidence of increased interest in papers published during the past two or three years, partly due to the discovery of a new tektite series in Indo-China, and more particularly to the discovery of silica-glass in association with meteorite impact at Henbury (Central Australia) and Wabar (Arabia).

Prof. Franz E. Suess, author of the term australite, as well as of the more comprehensive term tektite, has recently summed up the whole of the published evidence (Die Naturwissenschaften, vol. xxi., p. 857, December 8, 1933), and strongly supports the theory that these bodies are "glass meteorites."

The present paper is purely descriptive, touching upon questions of genesis only in so far as it is necessary to do so in order to establish a basis of classification. The chemical and physical properties of the australite(1) material (and of tektites generally) are now reasonably well known. The present paper may add something to our knowledge of the average forms and weights, as well as of the surface features and the general distribution of australites. The points that call for further physical investigation are the forms, and the internal and external structural features (flanges, rims, internal flow lines, anterior flow ridges, etc.).

II. LOCALITY, DISTRIBUTION, ETC.

The Shaw collection of australites was made almost wholly from an area of about 30,000 square miles of the arid and sub-arid region of southern Australia, on and adjoining the Nullarbor Plain, as shown in the attached map, fig. 1. It is a matter of common knowledge that a very large number, possibly many thousands, of unrecorded australites has also been found distributed over this area, lying upon the surface. So far as is known, however, there are no comprehensive collections of these objects comparable with that of Mr. Shaw, apart from the collection made by Mr. S. F. C. Cook, of Kalgoorlie.

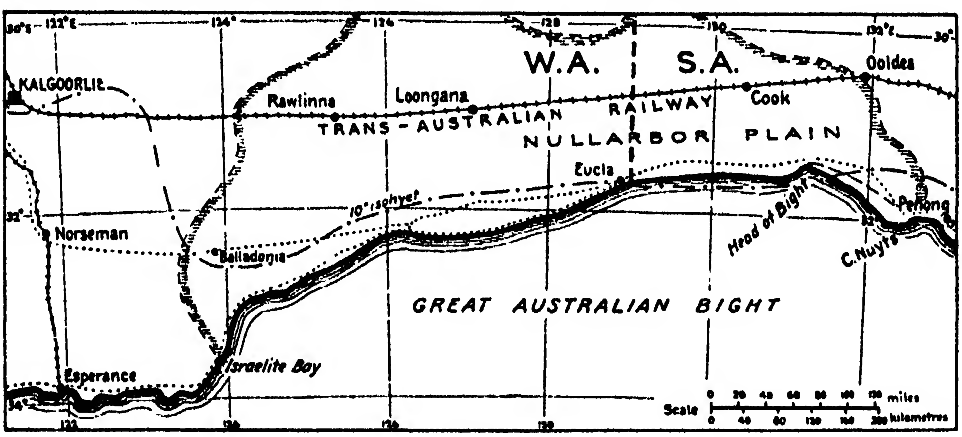


Fig. 1.

Sketch map of the locality where the Shaw collection was made, mainly along the coast between Eucla and Penong on the east, and Israelite Bay on the west; also along the Trans line between Rawlinna and Cook, and in the neighbourhood of Balladonia. The shaded broken line indicates the boundary of the tertiary limestones of the Nullarbor Plain; practically every specimen was found on this limestone area.

With one exception, to be noted later, this collection may be taken as representative of the average numbers, sizes, and types of australites as they lay widespread over the surface of the Nullarbor Plain. The area is a level plain, with a low and unreliable rainfall, and with no water-courses. It is a remarkably uniform geographical feature, a vast limestone plain with thin soils, without any

(1) Chemical composition: SiO_2 70+, Al_2O_3 13+, FeO and Fe_2O_3 6+, MgO 2+, CaO 3+, K_2O and Na_2O 4+, with traces of Mn, Ti, Ni, and Co. Specific gravity: 2·3 to 2·5. Micro-structure: glass throughout. Colour: Pitch-black by reflected light; amber-brown to bronze-green by transmitted light.

siliceous rocks whatever. Until the coming of the coastal telegraph line in the south and the transcontinental railway line in the north, the area was practically uninhabited and almost unvisited, either by white or black man, except in the extreme west. The rainfall, vegetation, etc., improve towards Israelite Bay, where considerable numbers of australites were found. The distribution seems to have been widespread, and this is supported by the information gained from accounts of the building of the telegraph lines and the transcontinental railway line, when large collections were made by the men engaged on these works. The aborigines along the east-west (Kalgoorlie to Port Augusta) railway line trade australite specimens with passing travellers.

Since the area concerned is almost wholly a monotonous limestone plain, covered with low and sparse vegetation, without water-courses, and uninhabited, the suggestion that the distribution of the australites has been carried out by (a) running water, or (b) aborigines, receives no support. On the other hand, the facts of the distribution in this area strongly uphold the general belief held by Australian investigators that for the most part the australites have been found in the positions where they originally fell. Exceptions occur elsewhere, where concentration has taken place in the tin drifts and alluvial gravels of wetter districts in parts of Australia and Tasmania.

In a recent note in "Nature" (April 21, 1934, page 605) it was stated that tektites are "usually found in alluvial deposits, and are often waterworn and corroded." It is a remarkable fact that the australites in the Shaw collection, whether whole or broken, show well-preserved surface features, even where sharp edges are concerned, such as flow-ridges, rims, and flanges.[2] Not more than 2% of the whole of the material in this collection shows the pitting or wearing of the surface and edges that may be ascribed to transport or erosion by wind or water; apart from fractures of the flange or rim, over 90% of these specimens have well-preserved surface features and a fresh and unworn appearance.

Mr. G. F. Dodwell, B.A., Government Astronomer of South Australia, has had unique opportunity for the personal collection of australites within the area where the Shaw collection was made. When engaged in fixing the boundary between Western Australia and South Australia, Mr. Dodwell was twice camped on the Nullarbor Plain at Deakin, 30° 46′ S., 128° 58′ E., for eight days in November, 1920, and for three weeks in April-May, 1921. He frequently walked out over the plain after lunch, and succeeded in collecting 86 specimens over an area of about one square mile. The specimens included 23 round forms, mostly lenses, one teardrop, four elongates and 58 fragments. He states that he was always sure of finding a few specimens lying exposed upon the surface on the thin soil or bare limestone which characterises this area. Mr. Dodwell is of opinion that about 250 pieces were collected by his party over an area of a square mile, and the locality had possibly been collected upon by men working on the East-West railway line. The pieces were, on the whole, fairly evenly distributed.

Mr. Shaw, whose duties as an officer of the Commonwealth Post and Telegraph Department led to his being stationed in this area for a considerable period, has kindly supplied the following notes regarding distribution:—"I started collecting australites about 30 years ago, and during that time I have given hundreds away to museums and to private people who were collectors. As they take a very high polish, I gave away a lot of them to be made up into mourning brooches during the war. They are very hard and at the same time brittle, and must be treated by a lapidary. The australites in my collection were found in a district

(2) Other tektites (billitonites, moldavites, and indochinites) seem, in comparison with australites, to be not only much less regular in form, but also much more eroded; they appear to have been subjected to erosion for a longer period; they are also without the flanges or rims characteristic of australites.

extending from Eucla in the south to a point on the Trans line about opposite Eucla to the north, then west to Israelite Bay and Esperance. The majority were found in the vicinity of Israelite Bay. The natives used to find them close to and on the salt lakes (claypans), most of them being too small for my eyes to distinguish. Unfortunately, I have given practically all the large ones away; in fact, I borrowed the two largest ones to send with the collection; they were a couple I gave away some years ago."

Mr. Shaw has mentioned the one point in which his collection cannot be regarded as normal and average. It is that he had a tendency to give away to his friends the larger and the more perfect specimens, and in that respect his collection has suffered. For instance, the average weight of the dumbbells (70 specimens) in the Shaw collection is 1·217 grams, while that of the dumbbells (6 specimens) in a collection of over 100 sent to me by Mr. George Aiston, of Marree, is 3·1 grams. The tendency of most museum collections is possibly the reverse of that of the Shaw collection; they tend to consist rather of the larger and the better shaped forms, with a definite lack of the characteristic smaller forms, which were probably far more abundant in nature.

Possibly the higher proportion of water-worn specimens in museum collections is due to the fact that many were collected from alluvial (gold, tin, etc.) gravels. It is worthy of mention that, until in later years the natives were exploited as collectors of australites, the chief collectors were miners working in alluvial deposits. Even as far back as 1855, and possibly earlier, australites were well known to the gold diggers, who called them "button stones," *vide* W. B. Clarke, Q.J.G.S., 1855, p. 403.

III. BASES OF CLASSIFICATION.

The method of classification adopted is based primarily on the forms of the australites, and secondarily upon measurements of the longer diameters or axes of the objects. The classification is, as far as possible, genetic. That is, it is based on the development of the various forms, one from another. From the work of

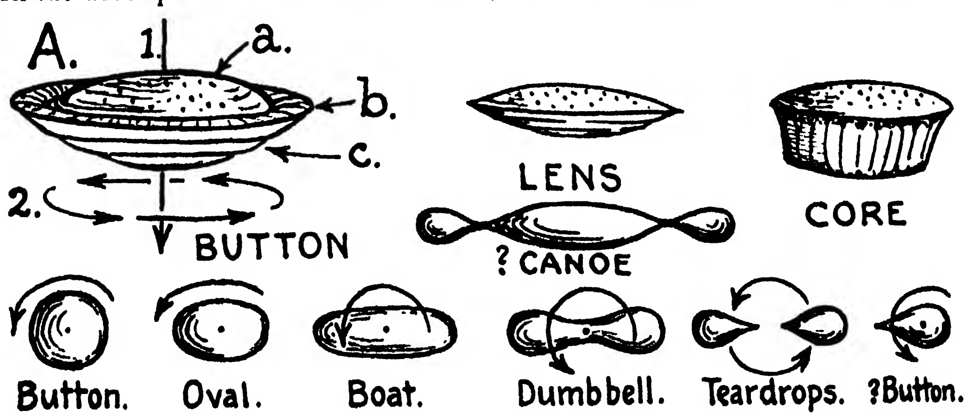


Fig. 2.

Sketches to illustrate the theory that is the basis of the terms used and of the genetic classification here attempted.

previous investigators a fairly clear idea has been gained of the successive steps in development of the australites, assuming them to have been blebs of molten glass moving forward through a gas and rotating rapidly in a plane normal to the direction of the movement. Thus we get the well-known series of forms as set out in fig. 2.

The commonest of all the australite forms is the typical "button," with or without a flange. Fig. 2A shows the method of development of this form, together with the descriptive terms used throughout this paper. A spherical bleb of glass (the "primary form") moving in the direction of arrow No. 1 and spinning in the direction of arrow No. 2 will fuse on the forward, or anterior, surface, and the melting glass will flow backward to form the flange or rim, producing the "secondary form." We thus get three well-marked parts which are characteristic of nearly all forms of australites, though the flange may not be well developed in all specimens (see fig. 2) :—

(a) The posterior surface, here called the back or the top of the object, which characteristically shows surface pittings due to gas bubbles, or an intricate pattern of flow lines in the glassy material, or both (see pl. ix.).

(b) The anterior surface, here called the front or bottom of the object, which is characterised by "flow-ridges," which may be concentric, spiral, or irregular; these are well shown in some of the plates.

(c) The surrounding flange or rim may be large as in Class A1a (the "buttons"), or very small as in Class A2a (the "lenses"), or subsequently lost by fracture, as in the greater number of australites recorded (see "core," fig. 2).

Round forms are by far the most abundant, and appear to be the most stable. In fig. 2 is shown a series of sketches to suggest the development of various forms from the button through the dumbbell to the teardrop; as several excellent samples testify, the tendency of the teardrop, when proceeding on its spinning flight, is to develop a flange and to approximate more closely to the button form (see pl. ix., No. E5).[3] Indeed, it does not require a very great effort of imagination to picture the whole of the known australites as derived from one original huge molten glassy sphere, successively dividing and re-dividing in the above-named sequence. Such a mental picture, which is suggested purely as an intellectual exercise, demands a relatively long period of travel through the gas in which the forms were developed.

A type, here called "canoes," pointed at both ends (pl. vi., A5a, 1-14), is somewhat puzzling, and Prof. Kerr Grant has suggested to the writer that it may be formed by the shedding of two "tear-drops," as suggested in the sketch in fig. 2.

These, then, are the bases of classification. It will be realized that there are no two australites in this collection which are alike, and although seven separate classes and 50 sub-classes have been necessary in order to make a reasonable classification, the possibility for a greater number of sub-classes was apparent, as was also the fact that almost every sub-class grades in both directions into other sub-classes, and the transitional forms are often somewhat difficult to place.

IV. NOMENCLATURE—GROUPS AND CLASSES.

No systematic attempt has previously been made to give names to the whole of the australite forms. A number of names, however, are fairly well recognised in the literature. Taking three that are well known, we have *(a)* bombs, *(b)* ovoids or ellipsoids, *(c)* buttons. Names such as "bomb" are undesirable in that they imply the method of origin, a point upon which we are still without positive knowledge. Terms such as ovoid, ellipsoid, apioid, etc., are also undesirable, as they connote exact mathematical forms, none of which occur as australites; that is to say, no two australites are alike in form, and no australite complies with the regularity of any one of the mathematical forms named. As we shall see later, when discussing the possibility of primary and secondary

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(3) Prof. Walter Howchin has, in his private collection, a fine example of a flanged button which preserves traces of a tear-drop ancestry.

australite forms, the primary forms possibly approximated to the various mathematical conceptions here referred to.

The term "button," which is the one most commonly adopted for popular use ("blackfellows' buttons"), is also widely used throughout scientific literature. It is an excellent term, being descriptive, easily remembered, and non-committal both as to exact form and origin. The writer has, therefore, throughout this paper used similar commonplace and non-committal terms for the names of the various groups. Wherever possible these have been taken from previous literature; in a few cases fresh terms have been devised.

It was necessary to classify the broken fragments as well as the whole ones, and the following two main groups were therefore formed:—

Group A.—Whole specimens, or with flanges broken or missing; total: 1,993 specimens.

Group B.—Broken pieces; total: 1,927 specimens.

The following are the names of the various classes of Group A:—

Class.	Name.	Number of Sub classes	Number of Specimens.	Average Weight in Grams.
A1	Buttons - -	12	275	1·305
A2	Lenses - -	11	1,094	·798
A3	Ovals - -	5	168	·939
A4	Boats - -	6	171	1·121
A5	Canoes - -	5	81	1·104
A6	Dumbbells - -	6	70	1·217
A7	Teardrops - -	5	134	·898
	Totals -	50	1,993	·931

It will be seen that the round specimens (buttons and lenses) predominate, there being 1,369 of them, with an average weight of ·884 grams. There are 490 elongates (ovals, boats, canoes, and dumbbells) with an average weight of 1·069 grams, and 134 teardrops with an average weight of ·898 grams. The question of the distribution of size and weight will be more fully dealt with in a later section.

Group B includes the broken pieces, **B1** comprising round forms, **B2** elongated forms, and **B3** nondescript pieces.

V. DESCRIPTION OF CLASSES AND SUB-CLASSES, GROUP A.

This portion of the paper should be read in conjunction with the accompanying plates, the reference numbers attached to the photographs of the various australites being the same as those used throughout this classification.

Class A1—Buttons, with the following sub-classes, examples of each of which are shown in the plates.

A1a.—Buttons with perfect flanges, 7 specimens, average weight 2·63 grams. These are the most striking and beautiful of all the forms known, and possibly represent the dominant type formed. See pl. iv., 1-12.

A1b.—Buttons with imperfect flanges, subdivided as follows; these are shown in pl. iv., Nos. 1-2 showing the upper and 3-6 the lower ridged surfaces:—

		No.	Av. Weight.
(i.)	imperfect flanges, half remaining - -	22	2·35 gms.
(ii.)	" " quarter to half remaining -	17	1·85 "
(iii.)	" " less than quarter remaining:		
	(a) 14–16 mm. dia. -	27	1·85 "
	(b) 10–14 " " -	43	1·15 "
	(c) < 10 " " -	17	·51 "

A1c.—This class consists of buttons in which cavities caused by gas bubbles appear on the surface. Some very striking forms are known in which a very large bubble or bubbles occupy the whole of the interior of the australite. A sub-class *(i.)* has been set apart for these forms, but there are no complete representatives in the Shaw collection; there is one large fragment that appears to be part of such a form.

A1c. (ii.*)* consists of those buttons which have the bubble cavity in the centre of the top of the button; 15 specimens, average weight ·98 grams (see pl. iv., A1c, 1-3).

A1c, (iii.*)* includes 36 specimens with one, two, or more open bubble cavities, which are not concentrically placed. The average weight is 1·08 grams.

A1d.—Buttons which have a peculiar and unexplained defacement, consisting of a parallel-sided groove, often curved, penetrating deep into the material of the australite. Including the fragments, 150 specimens in this collection show such features. They do not appear to be cracks due to contraction, and the writer has preferred to name them "saw-cuts," which they closely resemble, and which word can convey no possible implication as to their origin. They may be shrinkage cracks, but they do not look like it (see pl. iv., A1, 1-3).

A1e.—While the great majority of buttons have rounded (spheroidal) tops, there is a very definite class of somewhat smaller buttons with a tendency towards what Professor Skeats (Roy. Soc. Vic., 1914) has termed the "pine-seed form," almost or quite flat on the top. This class includes 67 specimens, with a fairly wide variety of size, etc., average weight ·47 grams (see pl. iv., A1e, 1-9). Rare samples have very wide, flat flanges.

A1f, which would include a very large number of the specimens of most museum collections, consists of "cores" (see fig. 2). That is to say, they are regular buttons from which the flanges have been broken off. It will be pointed out later that the flange is not closely connected to the main body of the australite, and that it is to be expected that the flanges may be easily removed by abrasion, insolation, temperature variation, bush fires, etc. After the flange is gone there appears to be a tendency for further flaking around the equatorial zone, so that the cores become smaller and smaller. A characteristic button core, showing the fractured zone and spherical top, is shown in pl. ix., E1, and a sketch in fig. 2.

The largest specimen in the Shaw collection is a core. It constitutes sub-class A1f *(i.)*, weighs 37·16 grams, is 37 mm. in diameter and 22·6 mm. thick. So far as can be ascertained, all the largest australites recorded, and most of the very large ones which the writer has personally examined, belong to this sub-class.

A1f, *(ii.)* consists of 16 smaller cores, average weight 2·83 grams. These forms are important; Thorp (W.A., 1913-1914) refers to them as "conical." They have in most cases lost the anterior fluxion ridges but retain the pitted or flow-lined spheroidal tops. Pl. iv., A1f, 1-6 show the upper surface, while Nos. 7-12 show them side on. The smallest cores (over 150 specimens) have been placed with the "fragments."

Class A2. Lenses.—Bi-convex forms, mostly with a sharp rim, the forward surface showing the usual flow ridges and the upper surface being nearly smooth or slightly pitted. The flange is usually not well developed, and is more conveniently distinguished by calling it a "rim" (see pl. v., A2a, 8-13). It may be that the lens is a development from the normal flanged button, having lost its flange in the course of development, and just started to develop a fresh one. In any case, it appears to be a very stable form and completely surpasses in numbers all other forms in the Shaw collection, being four times as abundant as

the various forms of buttons. There are 1,094 lenses in the collection, and 623 are shown on a reduced scale in pl. vii. See also three top rows in pl. v.

The lenses have been divided into sub-classes as follows, according to size. In the two rows of larger specimens, A2a, pl. vii., the upper row shows the bottom (ridged) surface, and the lower row shows the top (pitted) surface:—

A2a.—14 to 16 mm. diameter, 69 specimens, av. weight 1·68 grams.
A2b.—12 to 14 mm. diameter, 177 specimens, av. weight 1·22 grams.
A2c.—10 to 12 mm. diameter, 350 specimens, av. weight ·78 grams.
A2d.—8 to 10 mm. diameter, 341 specimens, av. weight ·48 grams.
A2e *(i.)*.—6 to 8 mm. diameter, larger, 77 specimens, av. weight ·286 grams.
A2e *(ii.)*.—6 to 8 mm. diameter, medium size, 12 specimens, av. weight ·221 grams.
A2e *(iii.)*—6 to 8 mm. diameter, smallest, 6 specimens, av. weight ·166 grams.

In this last-named sub-class occur the smallest recorded specimens. The extreme example is a very perfect lens of ·15 grams in weight.

A2f.—This sub-class is termed the "pitted discs." They tend to be flat on both sides and are heavily pitted on the top and bottom, with no sign of the usual external form and sculpture of the lens. They appear to have been derived from lens-shaped australites by erosion and abrasion. This group stands out from the others because, while most of the specimens in this collection have retained their external features with remarkable definiteness, these specimens appear to have undergone weathering or chemical erosion; even so, the erosion is in no case of an extreme type.

(i.)—Larger, 6 specimens, average weight 2·02 grams.
(ii.)—Intermediate, 44 specimens, average weight ·873 grams.
(iii.)—Smaller, 6 specimens, average weight ·46 grams.

A2g.—This is a peculiar and puzzling sub-class, not hitherto referred to, in which the top portion of the specimen has developed a series of ridges that may be likened to the edges of a pudding cloth which does not cover the whole pudding. They are better explained by the photograph shown on pl. ix., F1-12. They are here called "crinkly tops," and a similar series is found among the elongate specimens (sub-class A4f). Six round specimens, average weight ·78 grams. Plate ix. F, shows both elongate and round forms.

Class A3. Ovals.—The ovals require no special description. The sub-classes are as follows:—

A3a.—Ovals, with perfect flange. These are very beautiful objects, really "oval buttons." A specimen of this type was given by Sir Thomas Mitchell to Charles Darwin, and is regarded as the first recorded australite. Two specimens, average weight 2·575 grams (see pl. v., A3a, 1-2). Nos. 3, 4, 5, 6 show different aspects of the same pair of australites.

A3b.—Ovals, with flange missing or imperfect, long axis 18 to 21 mm., 18 specimens, av. weight 2·01 grams.
A3c.—As above, long axis 14 to 18 mm., 50 specimens, av. weight 1·22 grams.
A3d.—As above, long axis 10 to 14 mm., 81 specimens, av. weight ·64 grams.
A3e.—As above, long axis 8 to 10 mm., 17 specimens, av. weight ·214 grams.

Ovals are figured on pl. v.—top, bottom, and side views. The smallest oval specimen is a beautifully preserved sample with clear-cut edge and anterior flow ridges, weighing ·20 grams (pl. ix., E11).

Class A4. Boats.—The following are the sub-classes:—

A4a.—This group consists of specimens which are more elongate than the ovals and have somewhat parallel sides, but which had not yet developed "waists."

Most of these specimens have the flanges wholly missing or imperfect, but there is usually some definite trace of the existence of a larger or smaller flange or rim. The anterior flow ridges are often irregular. See pl. v., A4a, for top, bottom, and side views:—

A4a.—Long axis 20 to 30 mm., 15 specimens, average weight 2·24 grams.
A4b.—Long axis 18 to 22 mm., 75 specimens, average weight 1·35 grams.
A4c.—Long axis 14 to 18 mm., 52 specimens, average weight ·53 grams.
A4d.—Long axis 12 to 14 mm., 14 specimens, average weight ·356 grams.
A4e.—Here we have a peculiar and varied group of elongated australites, remarkably thin and flat in cross section, as shown by pl. viii., A4e, Nos. 1-4; Nos. 3 and 4 are two views of the same specimen. Most of the samples very clearly show sharp rims and flow ridges and many of them are translucent, and are amber-coloured by transmitted light. Eight specimens, average weight ·321 grams.[4]

A4f.—"Crinkly tops." The same comments apply as in sub-class A2g above; 7 specimens, average weight 1·65 grams.

Class A5. Canoes.—These are on the whole somewhat similar to boats, but are usually narrower and are pointed at both ends. See fig. 2 re possible origin. Many of them have a small but fairly perfect sharp equatorial rim; in a small number there is a flange, but it is imperfect or broken off (see pl. vi., A5a, 1-14; also A5, 1-4.) The following are the sub-classes:—

A5a.—Long axis 22 to 30 mm., 22 specimens, average weight 1·56 grams.
A5b.—Long axis 18 to 22 mm., 18 specimens, average weight 1·18 grams.
A5c.—Long axis 14 to 18 mm., 28 specimens, average weight ·631 grams.
A5d.—Long axis 12 to 14 mm., 7 specimens, average weight ·452 grams.
A5e.—These forms are termed "aberrant elongates" and include a series that cannot be placed in any other sub-class. Their peculiarities lie both in their forms and in their flow lines, and will be dealt with in some detail in a later section. In pl. viii., A5e, Nos. 1-4, show two views of each of two specimens: 1-2 has flow lines on both surfaces, 3-4 is abnormally crescentic in longitudinal section.

Class A6. Dumbbells.—These are a development from the boat type, in which the two ends tend to pull apart and thus to form a "waist," giving the characteristic dumbbell outline. A few dumbbells (the so-called "peanut" forms) are round and not lenticular in cross section, as shown in the specimen figured as A6a, Nos. 9 and 13, pl. vi. Few dumbbells show wide flanges, but many of them have evidence that a flange or rim was developed. The flange is often no more than a sharp rim, like those of the lenses and canoes. See pl. vi., A6a, 1-6, A6b, 1-4, A6a, 7-14; 7-10 are the same specimens as 11-14, but differently illuminated. The sub-classes are:—

A6a.—Long axis 30 to 35 mm., 5 specimens, average weight 2·648 grams.
A6b.—Long axis 25 to 30 mm., 23 specimens, average weight 1·457 grams.
A6c.—Long axis 20 to 25 mm., 25 specimens, average weight ·860 grams.
A6d.—Long axis 15 to 20 mm., 7 specimens, average weight ·51 grams.
A6e.—"Ladles." This is a peculiar group of aberrant dumbbells in which one end is characteristically larger than the other, and their rotation appears to have taken place with the larger end in an advanced position with respect to the smaller end. The flow lines characteristically extend up the "handle" of the ladle as shown in the photographs. They are particularly interesting forms. See

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(4) If australites tended to become smaller and smaller during flight, by fusion and evaporation, these forms may represent specimens that were approaching the stage of complete disappearance.

pl. viii., A6e, 1-7. A6e, Nos. 1 to 3, represent different aspects of the one specimen. 5 specimens, average weight 2·00 grams.

A6f.—Beans or Kidneys. These are flat, uninteresting specimens, which may be more closely related to the ovals than to the dumbbell forms. 5 specimens, average weight ·676 grams. Pl. viii., A6f, 1-2.

Class A7. Teardrops.—These are the forms which arise when a dumbbell in its revolutions has torn completely apart. Though all the teardrops in the Shaw collection are small, some very large ones are in existence, and samples of these larger ones are shown in the photographs (pl. ix., E5 and E6). Some of the most puzzling forms, which are also rare, are those in which we find a teardrop continuing its revolution and developing the form of the flanged button, but still retaining evidence of its teardrop ancestry (see pl. ix., No. E5). The sub-classes are:—

A7a.—Short axis 12 to 15 mm., 6 specimens, average weight 1·92 grams.
A7b.—Short axis 10 to 12 mm., 21 specimens, average weight 1·23 grams.
A7c.—Short axis 8 to 10 mm., 45 specimens, average weight ·731 grams.
A7d.—Short axis 6 to 8 mm., 39 specimens, average weight ·417 grams.
A7e.—"Air bombs," and other exceptional flow-lined forms. This is one of the most interesting sub-classes, and one in which no two specimens very closely resemble one another. Certain puzzling features of this sub-class are dealt with later, and they are shown on pl. viii., A7e, 1-14. Nos. 5 and 12 are two views of the same form, the "air bomb." 23 specimens, average weight 1·472 grams.

VI. DESCRIPTION OF CLASSES AND SUB-CLASSES, GROUP B.

This group, as already explained, consists of broken specimens and fragments. Apart from the fracturing that has taken place, the external appearance of these fragments is in most cases quite fresh and unworn. Possibly the greater part of this fracturing is due to grass and scrub fires passing over the country where they lay. A very high proportion have fragments of well-developed flanges attached to them; a careful and detailed examination, involving the handling of each specimen many times, failed to reveal that any two parts belonged to the one australite. There was one exception, mentioned later. It is reasonable to assume that almost every piece in Group B represents a separate australite.

With one exception these fragments are all of the normal sizes recorded for Group A. It was, therefore, not necessary to weigh them, as the weights would be of no particular value. The exception, so far as size is concerned, was a fragment of a large dumbbell, without flange or rim, the weight of which was 24·85 grams, probably representing an original specimen which weighed at least 80 grams.

There are three classes in this group:—

Class B1.—Round forms, mostly buttons and lenses.

Class B2.—Elongate forms, including ovals, boats, and dumbbells; the teardrop fragments have also been included.

Class B3.—Nondescript fragments.

Class B1: Round Forms.—A brief description of each sub-class and the numbers in each are as follows:—

B1a.—Buttons with saw-cuts, fragment greater than half, 18 specimens.
B1b.—Buttons with saw-cuts, fragments less than half, 66 specimens.
B1c.—Buttons with concentric fractures, large, flanged, 32 specimens (pl. viii., B1c, 1-5).
B1d.—Buttons with concentric fractures, small, with imperfect flanges, 187 specimens.

B1e.—Fragments consisting of central conical pieces such as would result from the two foregoing sub-classes, 87 specimens (p. viii., B1e, 1-6).
B1f.—Button cores, larger, 20 specimens.
B1g.—Button cores, smaller, 106 specimens.
B1h.—Button cores, weathered and abraded, 26 specimens.
B1i.—Button fragments with bubble cavities, 28 specimens.
B1j.—Button fragments with flanges, larger, 23 specimens.
B1k.—Button fragments with flanges, smaller, 181 specimens.
B1l.—Fragments without flanges, possibly of lenses, 206 specimens.

Class B2: Elongate Forms.—The following are the sub-classes:—

B2a *(i.)*.—Elongate forms with saw-cuts, ordinary, 39 specimens.
B2a *(ii.)*.—Elongate forms with saw-cuts ("trilobites"), 20 specimens (see pl. viii., B2a, 1-7).
B2b.—Varied elongates with concentric fractures, 51 specimens.
B2c.—Elongate fragments, with unusual "flow-ridges," etc., 10 specimens.
B2d.—Elongate forms with bubble cavities, 42 specimens.
B2e.—Elongate forms, mostly cores of varied types, some very irregular, 36 specimens.
B2f *(i.)*—Boats, larger fragments, 130 specimens.
B2f *(ii.)*.—Boats, smaller fragments, 172 specimens.
B2g *(i.)*.—Dumbbell fragments, larger, 27 specimens; this sub-class includes the large fragment already mentioned, 24·85 grams.
B2g *(ii.)*.—Dumbbells, small fragments, 52 specimens.
B2h.—Teardrop fragments, 24 specimens.

Class B3: Unclassified Fragments.—The following are the sub-classes:—

B3a.—Nondescript fragments, 340 specimens, of which the total weight is about 150 grams.
B3b.—Flakes, accidental or aboriginal, 4 specimens.
B3c.—Foreign bodies, 10 specimens. In each of four collections which the writer has examined, it has been found necessary to recognise the fact that a small proportion of the bodies collected are not really australites at all. Among the various pseudo-australites one finds fragments of dark-coloured rock, bits of hard charcoal, or small pieces of well-polished limonite; in the Shaw collection there were four plant-seeds of a peculiar kind which looked remarkably like special types of australites, and were so regarded until their specific gravity was determined.

VII. SMOKE BOMBS.

Mr. D. J. Mahony, Director of the National Museum, Melbourne, has kindly drawn under my notice certain objects called "smoke bombs" (also called "slag bombs"), which may be collected from the surface of any part of a railway train upon which material from the smoke of the engine falls. Mr. Mahony further supplied a photograph which he exhibited at a meeting of the Royal Society of Victoria somewhat over 20 years ago (Summers, A.A.A.S., Melb., 1913, pp. 194-5), and which is reproduced in fig. 3.

Although these forms are microscopic, one realizes at once that they contain forms similar in outline to those of all the commoner australites—buttons, ovals, boats, dumbbells, teardrops, etc. Those shown in fig. 3 are magnified about six diameters. By the courtesy of Mr. E. H. Shapter a supply of dust was obtained, taken from the hollows at the rear end of the tender of a mountain type engine, as well as some dust from the inside of the smoke-box of a suburban engine. No

blebs were found in the latter sample, and an examination of the material from the tender showed, in the first place, a predominance of coke particles.

When these had been floated or blown away the remaining material was found to contain innumerable microscopic forms comparable to those shown in fig. 3, but even more microscopic in size. They were of various colours—transparent, china-white, silver-grey, and so on. Nearly every one contained a large number of minute gas bubbles in the interior. The forms, on the whole, had very clean surfaces, but some were tubercled, though none were pitted or grooved so far as could be detected. Tiny spheroids were by far the most abundant forms, but dumbbells, pears, teardrops and other similar types were readily to be found. Similar forms have been recorded from blebs of wind-blown lava (Hawaii) and from blebs of fused silica from meteoritic impact (Henbury).

In spite of this striking similarity, it is necessary to emphasise the point that in all the thousands of these smoke bombs which were examined microscopically there was not one form which really resembled a characteristic australite form. This leads to the necessity for recognising, in any discussion of the genesis of australites, two forms:—

(a) The primary form, probably similar to those of the smoke bombs, as originally developed in the case of each australite.

(b) The secondary form, which is a lessened and flatter form in each case, due to the fusing of material from the forward portion and its backward flow to form the flange, or perhaps a series of flanges, if these were shed during flight.

Each australite, therefore, as we know it, appears to represent a portion, mainly the posterior portion, of the original form, a considerable part of the anterior portion having disappeared or been displaced due to friction and fusing; the possibility of evaporation must also be considered.

Walcott (Royal Society of Victoria, 1908, p. 34) pointed out the remarkable difference between the top and the bottom (back and front) portions of each australite. "These two hemispheroidal portions," he wrote, "are sharply defined by the ridge, as if two diverse agencies were at work in their formation."

It would appear that the secret of the origin of the australites must be sought from these two aspects: *(a)* The sources of the material and the forces that formed the original regular "smoke bomb" types of forms; *(b)* the rapid forward movement, spinning, through a gas, with fusion of the forward surface and the formation of flanges, rims, and flow-ridges.

VIII. FLANGES AND RIMS.

These are among the most characteristic features of australites, and in well-developed forms they are very regular and beautiful, as shown in pl. iv., top row. The possession of these flanges, together with their more regular forms, places the australites in a class distinct from other tektites, such as the schonites, the moldavites, the billitonites, the indochinites, and the doubtful tektites called queenstownites.

In some cases, as in the lenses, canoes, etc., the flange may be a mere projecting, sharp edge (herein called a "rim"), while in its fullest development (as a "flange") it occurs as in fig. 2A and in the top portion of pl. iv. The evidence of the Shaw collection is to the effect that almost all australites underwent fusion on the front surface and developed a flange or a rim. The rare exceptions exist in single cases such as the air bomb, pl. viii., A7e, 5 and 13, the large teardrop, pl. ix., E6 (which may be water-worn), and in other forms which possibly changed their direction during flight.

It is necessary that attention should be drawn to the precarious connection that exists between the flange and the body of the australite. This is very clearly brought out in the beautiful microscopic sections published by E. J. Dunn (Bulletin No. 27, Geological Survey of Victoria, 1912), a copy of one of which is reproduced in fig. 3. It will be seen that the flange is connected with the main body only at the forward end, and then only by a thin strip of glassy material which was in the process of flowing backward when solidification took place.

With the loss of the flange the button becomes a core, characteristic examples of which are shown in pl. iv., A1f, 1-12. There appears to be a tendency for further flaking along the equatorial zone, and the core tends to become smaller and smaller. These cores are perhaps the commonest forms in most museum collections. This particular type of fracture may be the result of internal strains in the body of the australite. Several large australite specimens not belonging to the Shaw collection were courteously lent by the South Australian Museum, to illustrate the characteristic belt of flaking along the "flange zone." These are shown in pl. ix.: Button (E1), dumbbell (E3), boat (E7), and teardrop (E6).

Kerr Grant (Roy. Soc. Vic., 1908, p. 447) refers to possible markings on australites due to impact while in the plastic condition. In this collection there has been noted but one mark capable of such interpretation, and this is shown fairly clearly in two views on pl. iv., A1a, Nos. 7 and 10. This particular marking might be better explained as a variation in fusion and flow, owing to the presence of a bubble cavity (which can be seen in the illustration). Marks of impact may be considered as non-existent upon australites. The evidence is thus in favour of the belief that these bodies were considerably slowed down during the latter part of their flight, with consequent cooling and solidification. It cannot be doubted that all of them reached the earth's surface as solid bodies.

IX. FLOW RIDGES.

The flow ridges which form on the front surface of the australites are very well shown in many of the plates. The ridges are very characteristic, and in the majority of the specimens in the Shaw collection they are well preserved. There is, on the whole, a noteworthy evenness in the distance from crest to crest of the waves which were developed in the molten glass. The average width of the grooves between the flow ridges is about 3 mm. The variations noted are from 2 to 4 mm. (see pl. viii., A6e, 1-7).

On the round forms the grooves are sometimes spiral and sometimes concentric. Out of 75 buttons with well-developed grooves, selected at random, there were 42 in which the flow ridges were arranged in concentric circles, 15 with a clockwise spiral and 18 with an anti-clockwise spiral. The regularity of these waves is perhaps best indicated in the microscopic section shown in fig. 3, where the outline of six successive flow waves may be clearly distinguished.

In the oval and most elongate forms the flow ridges behave somewhat as they do in the buttons and lenses. However, as may be seen from figs. 1 to 14, pl. viii., A7e, they are in other forms sometimes quite irregular and sometimes with curious symmetrical closed patterns.[5] A few forms, particularly in Class A5 and A7, suggest that the objects changed their direction during flight, as they

[5] It is suggested that the peculiarities of the more unusual forms, which include sub-classes **A5** (canoes), **A5e** (aberrant elongates) and **A7e** (air-bombs and other curious flow-lined forms), may be explained by their derivation from a "double-waisted dumbbell" as sketched in Fig. 2; the shedding of one tear-drop prior to the other would upset the equilibrium of the body and necessitate readjustment, possibly causing a fresh orientation towards the direction of flight, with the development of a new set of flow-ridges.

have flow ridges on both "front" and "back." Others appear to have moved lengthwise (end on) through the air and to have developed grooves along their whole length. Some of the most striking of these features are shown in the photographs, and need no further detailed description.

A peculiar phase of the flow of material appears to be shown in a small percentage of the objects which are here classified as the "crinkly tops," sub-classes A2g and A4f. These forms characteristically show little or no sign of a flange, but have definite flow ridges on their anterior face.

It is suggested that the material which fused and flowed backwards did not form a projecting flange, but crept round the back of the object and covered up portion of the original surface, all excepting the central part. This peculiar appearance is shown in the photographs in pl. ix., F1-12, all of which show the "top" (back) of the specimens.

X. INTERNAL STRUCTURES.

The work done on this collection of australites, coupled with a study of the previous literature on the matter, emphasises the need for a closer physical investigation of the internal structures. This is particularly the case when one comes to consider the distinction between the primary forms and the secondary

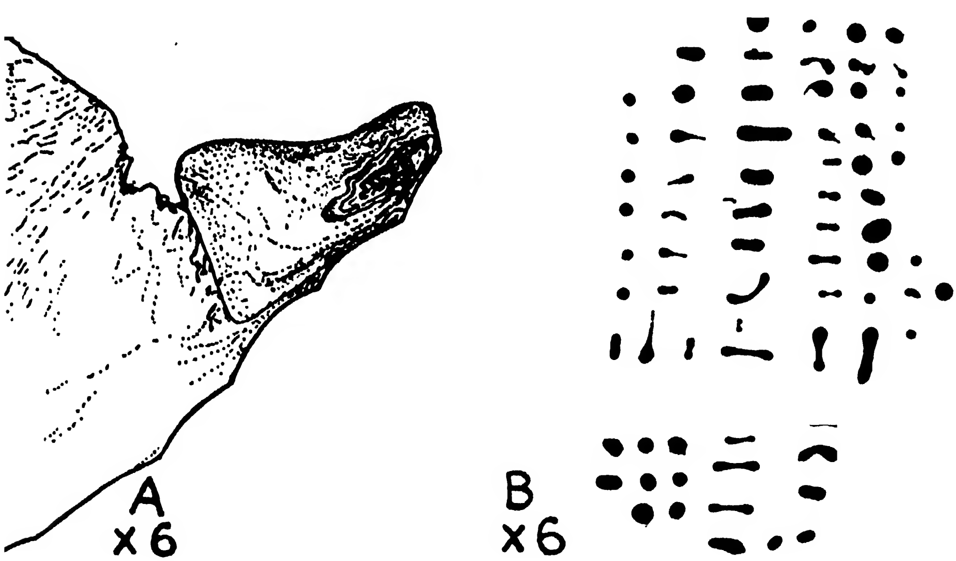


Fig. 3.

A represents a microscopic section through portion of a flanged button, magnified six diameters, after E. J. Dunn. Note: (a) the internal flow lines in both the body of the australite and in the flange, (b) the wave crests of the flow ridges on the front (lower) face, and (c) the imperfect union between the material of the flange and the body of the object. B represents "smoke bombs," from D. J. Mahony, magnified six diameters, as described in the context.

forms of australites, and to endeavour to separate and distinguish the two sets of forces which have possibly been in operation in producing the completed object.

The internal flow lines of the material of the flange are shown in fig. 3, and their arrangement is of a striking and puzzling character. The flow lines that may be detected within the interior of the glassy mass that forms the body of

the australite are equally puzzling, and are remarkably complex in many cases. These internal flow lines, together with the gas bubbles and their arrangement, must necessarily all take part in the story of the "primary" formation of the australites, while the fused "skin" of the front of the australite, the anterior flow ridges, and the almost bubble-free, flow-lined flange, has to do with the "secondary" forms impressed upon the australites. The flow lines (not flow ridges) sometimes show on the surface, as in three specimens selected to illustrate that point in pl. ix. Of these No. E2 is a button (110 grams), lent by Mr. S. F. C. Cook, of Kalgoorlie; No. E8, a boat, lent by Prof. Kerr Grant; and No. E4, a dumbbell, lent by the S.A. Museum authorities.

In studying the fragments classified under Group B some interesting features were noted, such as the gas cavities, concentric fractures, and "saw-cuts." Minute pits on the posterior surface, due to burst gas bubbles, are very common. Larger bubble cavities are shown in plate iv., A1c. These naturally tend to be at the back of the object, though occasionally one is found upon the flow-ridged (front) surface. Among the fragments there are many which obviously belonged to forms that contained bubbles up to 2 or 3 centimetres in diameter.

Among the fractures, one particular type (see Nos. 1-5, pl. viii., B1c) consisted of concentric fractures. These occur both in the button type and in the elongates, but tend to have a flatter angle in the latter than in the buttons. The photographs will provide sufficient description of the features, and it will be noted that over 270 separate pieces of the Shaw collection show concentric fractures. It may be the outward physical sign of an inward physical structure or strain. The pieces which come out of these concentric breaks are almost conical in form, but usually have some irregularity, as shown in Nos. 1-6, pl. viii., B1e. Possibly most of the fragmentation was due to bush and scrub fires, and to the rapid alternation of extremes of heat and cold.

A considerable amount of time was spent in the endeavour to find two pieces in the 2,000 fragments of the Shaw collection which fitted one another, and success was achieved in one case, where the fragment of a flanged button with a concentric fracture was mated with a conical-centre fragment. There is, of course, a possibility that this fracture took place within the box during transport.

Brief mention will be made of the features termed "saw-cuts." The reason for this name is given elsewhere, and examples are shown in pl. iv., A1d. Counting both the whole and broken specimens, not less than 150 showed definite saw-cuts. These markings are parallel-sided and usually penetrate deep into the australite. They have not the appearance of shrinkage cracks. The appearance is more as if streaks of some soluble material had been originally incorporated in the glass and had later been weathered out, but they may be due to some peculiar type of shrinkage which occurs at some stage in the cooling of a glassy mass. They do not tally with anything known to me from common experience. Somewhat similar markings, but of a more shallow type, have been noted on billitonites, moldavites, and ordinary obsidian pebbles, as figured by G. P. Merrill (Proc. U.S. Nat. Mus., vol. xl., pl. 61-62, 1911).

XI. FORMS AND WEIGHTS, DISTRIBUTION CURVE.

Just as the spherules are by far the most abundant forms among the smoke bombs, so are buttons the commonest forms among australites. Counting the whole of the 3,576 identifiable pieces in the Shaw collection, 2,349 are "rounds" and 1,227 are "elongates," a ratio of about twice as many rounds as elongates (including teardrops). This ratio does not tally with other estimates made, but it is more likely to be correct (thanks to Mr. Shaw's patient collecting) as it deals with a much larger collection and one of a more comprehensive type than any hitherto dealt with.

Table of Weights.

Average Weight of Group in Grams.	Number in Group Round.	Elongate.	Total.
< ·2	6	—	6
·2– ·4	89	39	128
·4– ·6	431	66	497
·6– ·8	356	114	470
·8–1·0	59	25	84
1 –1·2	79	18	97
1·2–1·4	177	125	302
1·4–1·6	—	45	45
1·6–1·8	69	7	76
1·8–2·0	44	—	44
2·0–2·2	6	29	35
2·2–2·4	22	15	37
2·4–2·6	7	2	9
2·6–2·8	7	5	12
2·8–3	16	—	16
	1,368	490	1,858
	Av. ·885 grams	Av. 1·069 grams	Av. ·934 grams

The general and relative weights of the australites in this collection have been investigated. The average weight of the "whole" specimens is nearly one gram (·931). The accompanying table shows the average weight in grams of each group of 1,858 complete australites, the round forms separate from the elongated forms. These weights were taken in groups at intervals of ·2 grams. When the distribution curve was plotted, as shown in fig. 4, it was found to have two distinct peaks, one about ·6 to ·8 grams and one at 1·4 grams.

This led to a re-examination of the weights, and it was found that most of the individual groups gave an adequate representation of their average weight. The particular sub-classes that were included in the 1·4 section, however, were of very varied sizes. They included 177 specimens of sub-classes A2b, 50 specimens of sub-class A3c, and 75 specimens of sub-class A4b. A number of the largest and the smallest were taken out of these sub-classes and weighed separately, and more detailed averages obtained. The re-distribution thus effected enable the probable distribution curve to be plotted as shown by the broken line in fig. 4. This distribution curve also shows its peak at about the average weight of the australites in this collection.

XII. LARGEST AND SMALLEST SPECIMENS.

Though there appear to be few very small australites, just as there are few very large ones, yet there is a remarkably wide range of variation. The smallest specimen in the Shaw collection weighs scarcely ·15 grams, while the largest specimen that has come under notice weighs 218 grams; that is to say, the largest known is 1,450 times as large as the smallest known.

It has already been mentioned that the Shaw collection is somewhat lacking in the larger specimens. Mr. Shaw has explained the lack of such examples as follows:—"I gave away several of the perfect button-with-flange type, some of which did not have a blemish of any sort. I gave away or lost at least half a dozen as large, if not larger, than the biggest (37 grams) I sent you. The lack of the usual proportion of larger ones amongst the collection is due to a certain extent to the fact that when giving away these stones, I allowed people to pick them out themselves. They nearly always picked a size suitable for mourning brooches; these would not be very large and not too small."

In support of the distribution curve shown in fig. 4 it may be suggested, from the writer's knowledge of the museum collections of Australia and of various other private collections, that the distribution curve is approximately correct for australites generally.

Very large australites are rare. For purposes of record, note is made of the following:—The largest known specimen appears to be that mentioned by Dr. Glauert, Curator of the Western Australian Museum, in a personal letter (27/3/34). It is No. 4,455 in the Museum collection and weighs 218 grams. No. 3,491 in the same collection weighs 147 grams, and No. 11,177 weighs 116 grams.

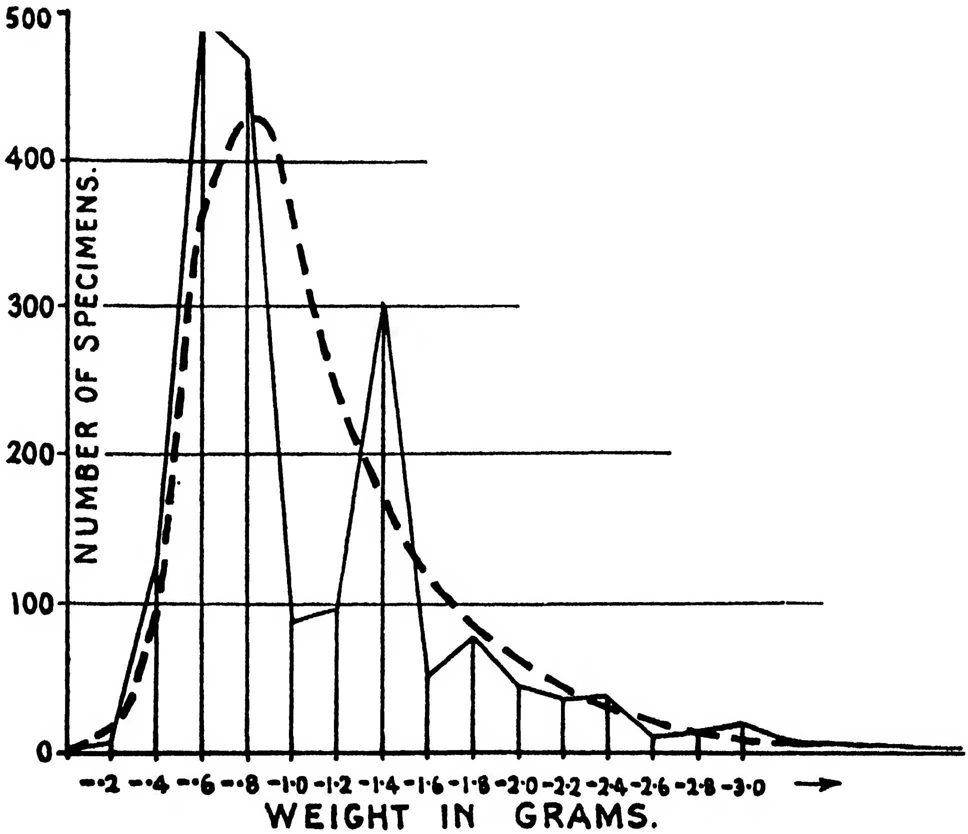


Fig. 4.

Distribution curve of the weights of australites, as described in the context.

The last-named specimen, of which there is a cast in the British Museum, was found by Sir John Forrest, and has long been regarded as the largest known australite. Mr. Shaw states that "the largest he remembers seeing was perfectly round and weighed about 142 grams (5 ozs.). This was sent to a jeweller in Melbourne, and it split into pieces when they were treating it; it was then thrown away—at least that was the explanation given. This specimen was found in the vicinity of Eucla by a native woman; the native name for this stone is Nooloo." The largest specimen known to the writer from this area is shown in plate ix., and is in the collection of Mr. S. F. C. Cook, of Kalgoorlie. It was found at Norseman (see fig. 1), and (as kindly determined by Sir Douglas Mawson) weighs 110·575 grams, and has a specific gravity of 2·44. It is approximately

circular in plan, 51 mm. in diameter, and 33·8 mm. thick. Of the large specimens shown in plate ix., in illustration of various features, the following are the names of the owners and the localities where found:—E1, W. M. McDonald, Loxton, S.A.; E2, S. F. C. Cook, Norseman, W.A.; E3, S.A. Museum, Wirramutta, S.A.; E4, S.A. Museum, Yunta, S.A.; E5, S.A. Museum, Renmark, S.A.; E6, S.A. Museum, Diamantina (S.A. or Q.); E7, S.A. Museum, Mount Gambier, S.A.; E8, Prof. Kerr Grant, Central Australia.

When we come to consider the smallest known specimens, we find that Dr. Thorp, of Western Australia, in 1913 recorded the smallest australite as one weighing 4·9 grains (·317 grams). In 1914 Professor Skeats, in the Victorian Royal Society, described a disc-like form weighing ·3184 grams.

The Shaw collection is rich in small specimens. From the smallest group of the lenses, A2e (iii.), the average weight of six is ·166 grams, and of these the smallest and most perfect, which is 7·25 mm. in diameter and 2·5 mm. thick in the centre, weighs ·15 grams—much smaller than any hitherto recorded. It is shown as figure E9, plate ix. The smallest oval in the Shaw collection is 10·1 mm. long, 6·4 mm. wide and 2·9 mm. thick, and weighs ·2 grams. It is shown in figure E11, plate ix.

Thanks are due to Messrs. J. A. Tillett, H. E. Powell, F. E. Brice, and R. F. Brand for their painstaking assistance in the preparation of the plates.

XIII. SUMMARY AND CONCLUSIONS.

The collection of australites (tektites) made by Mr. W. H. C. Shaw, of Perth, W.A., has been classified and described.

A basis of classification and simple nomenclature is set out, and the distribution of forms and weights is analysed.

The general external structures of the 3,920 pieces in this collection are described and commented upon.

The distribution of australites on the streamless limestone Nullarbor Plains is described.

The evidence of this collection supports the idea that australites are glass meteorites, that they all fell at one time, in a pre-historic period, and that they were fairly evenly distributed over the area concerned.

It appears also that australite forms and structures should be considered from two distinct points of view:—*(a)* the primary or original forms of glass blebs, with their internal flow-lines and gas bubbles, and *(b)* the secondary forms due to fusion and flow of the glass on the front portion of the bodies, forming flanges, rims, and flow-ridges. The primary forms may be due to extra-terrestrial happenings, and the secondary forms to a spinning flight through the earth's atmosphere.

DESCRIPTION OF PLATES.

Plate IV.

Australites. Button types, natural size; top, bottom and side views.

Plate V.

Australites. Lens, oval, and boat types, natural size; top, bottom, and side views.

Plate VI.

Australites. Canoe, dumbbell, and teardrop types, natural size; top, bottom and side views.

Plate VII.

Australites. Lens type, reduced in scale; 623 of the 1,094 lens forms in the Shaw collection are shown.

Plate VIII.

Australites. Various unusual and aberrant forms and fragments.

Plate IX.

Various types of Australites. Natural size. To illustrate structural and surface features.

THE BLUE METAL LIMESTONE AND ITS ASSOCIATED BEDS

By T. A. Barnes, B.Sc., and A. W. Kleeman, B.Sc.

[Read July 12, 1934.]

The main localities of the Blue Metal Limestone have been ably described by Professor Howchin[1] in his paper on the Adelaide Series. He has there given a list of the places in which the Blue Metal may be found and its general position in the Adelaide Series. The object of the present writers was to take the Blue Metal Limestone in a type locality, and by mapping to determine its thickness and associated beds and its general relations to the Thick Quartzites below and the Glen Osmond and Mitcham quartzites above. The area chosen was a portion of the foothills between Burnside and Glen Osmond. For detailed mapping of the Blue Metal Series, Goldsack's Quarries at Beaumont was chosen, as here the dip is sensibly constant. Analyses were made of the "limestone" from various localities.

At Beaumont a section was run across the outcrops of the limestone and the vertical succession of beds obtained, as set out in detail in the following table, where the thickness of each band is indicated:—

	Glen Osmond Clay Slates	1,540 ft.
13.	LIMESTONE	1 ,,
	Phyllites	12 ,,
12.	LIMESTONE	4 ,,
	Phyllites	47 ,,
11.	LIMESTONE	9 ,,
	Phyllites	20 ,,
10	LIMESTONE	2 ,,
	Phyllites	31 ,,
9.	LIMESTONE	1 ,,
	Phyllites	2 ,,
	Quartzites	3 ,,
	Phyllites	8 ,,
	Quartzites	9 ,,
	Phyllites	12 ,,
8.	LIMESTONE	2 ,,
	Phyllites	4 ,,
7.	LIMESTONE	2 ft.
	Phyllites	5 ,,
	Quartzite	7 ,,
	Phyllites	14 ,,
6.	LIMESTONE	1½ ,,
	Phyllites	5 ,,
5.	LIMESTONE	2½ ,,
	Phyllites	4 ,,
4.	LIMESTONE	1 ,,
	Phyllites	58 ,,
3.	LIMESTONE	3 ,,
	Calc. Phyllites	10 ,,
2.	LIMESTONE	6 ,,
	Phyllites	69 ,,
1.	LIMESTONE	15 ,,
	Lower Phyllites	1,000 ,, (?)

The base was taken at the bottom of the main 15-foot bed which is exposed in the western quarry. The top was a thin limestone which forms a rather inconspicuous outcrop near the top of the hill almost directly south of the eastern quarry. This is 370 feet stratigraphically above the datum. In this thickness is included 49 feet of limestone and 3 bands of quartzites. The remainder of the rocks may be styled calc-phyllites. The phyllites do not outcrop as the quartzites and limestones do. The phyllite where seen varies from an almost argillaceous type to some which becomes blue in colour and passes into argillaceous limestone. These highly calcareous types are the metamorphosed equivalents of marls.

From this type locality the Blue Metal beds can be followed in a northeasterly direction and across a small stream and up on to the opposite hillside, where they suddenly cut out against a bar of quartzite. This was considered a fault breccia by Professor Howchin. A very similar rock has been seen by the

[1] Howchin, W., "Geology of the Mount Lofty Ranges; Part II. (The lower and basal beds of the Cambrian"); Proc. Roy. Soc., vol. xxx., 1906, pp. 227-262.

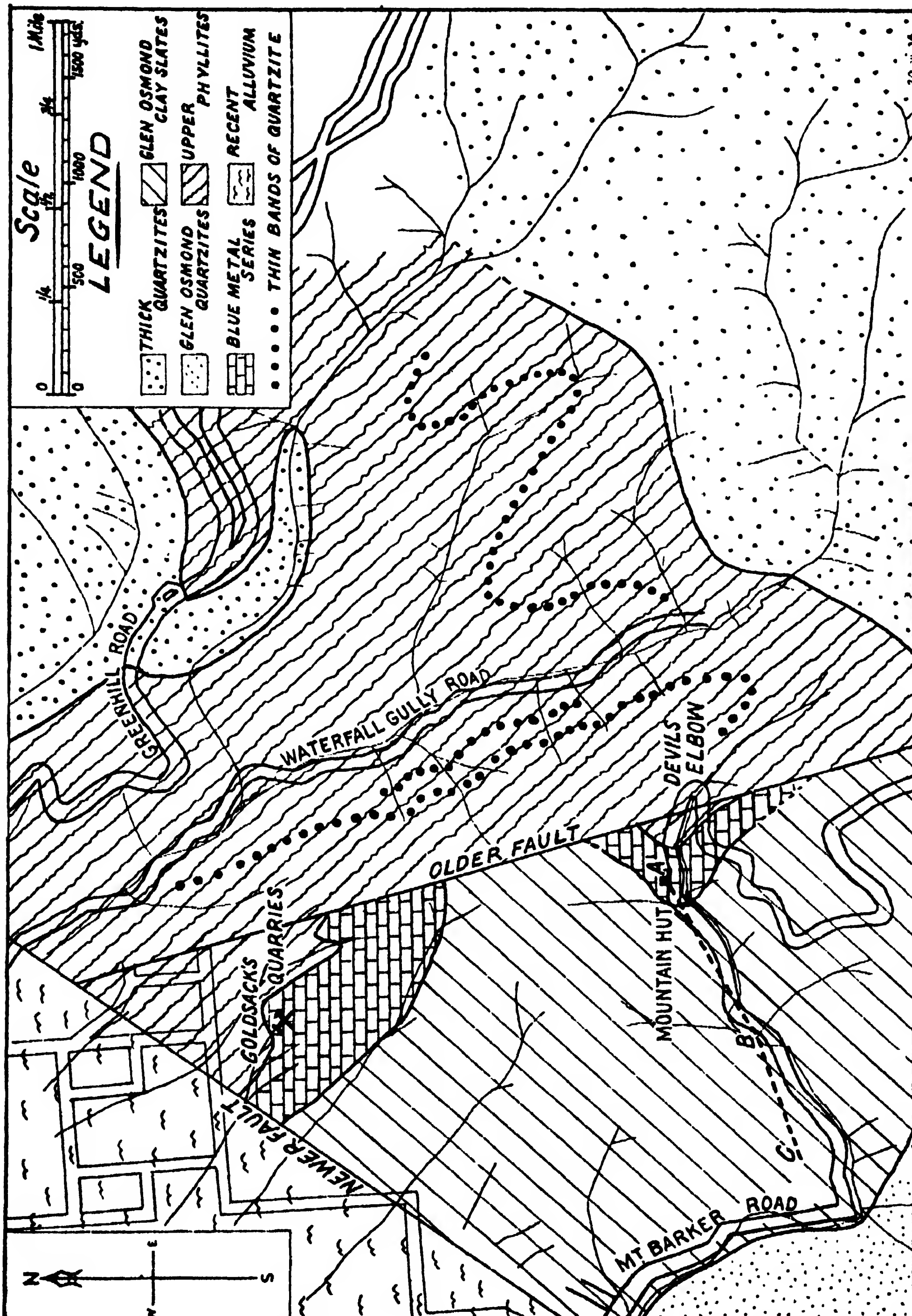


Fig. 1.
Locality Map.

writers filling a fault cutting the Blue Metal north of Stonyfell quartzite quarries. The main bed can be traced westward a short distance before it is lost beneath the alluvium which covers the main fault scarp bounding the Adelaide Hills. The thick bed near the top of the series can be seen on the south side of the valley south of Goldsack's quarries. It can be traced in a south-easterly direction, making a bold outcrop till it suddenly disappears. Another band can be seen on the north side of this valley, and ceases along the same line as the other two outcrops (see map, fig. 1).

The main beds of the Blue Metal are again well seen in the quarries near Mountain Hut on the Mount Barker Road. The bands corresponding to bands II. and III. in the Beaumont area are seen in two small quarries opposite the Mountain Hut and in a cutting behind the stables attached to Mountain Hut. The beds can be traced by surface outcrop and a line of small pits to a large quarry 200 yards N.70°E. of the Mountain Hut. There is no trace of the limestone north or east of this point. Tracing the beds to the south, they appear again in a large quarry 200 yards from the Devil's Elbow on the southern side of the hairpin bend. From here they can be traced around the flank of the hill to another quarry 350 yards due south of the Devil's Elbow. Here they are lost again. In this section the succession of beds is very similar to that at Beaumont.

Diligent search was made for the Blue Metal between Burnside and the Devil's Elbow and south of the latter locality, but without success. Accordingly, on this evidence, and the evidence of the fault breccia at Beaumont, the writers have postulated a fault striking N.10°W., which has caused the western block to move down relative to the eastern block.

For this reason, in the area under discussion, it was found impossible to find the relations and thickness of strata between the Blue Metal and the Thick Quartzite. The relation between the Blue Metal and the Glen Osmond and Mitcham Quartzites can best be seen in a section E.-W. along the Mount Barker Road from Mountain Hut to the Glen Osmond quartzite quarries. The section on the south side of the road is difficult to follow owing to lack of outcrops. Accordingly a section, line A.B.C. on map, was run along the road from the Mountain Hut to the private road to Mount Osmond Club House (fig. 2). The section then follows this road

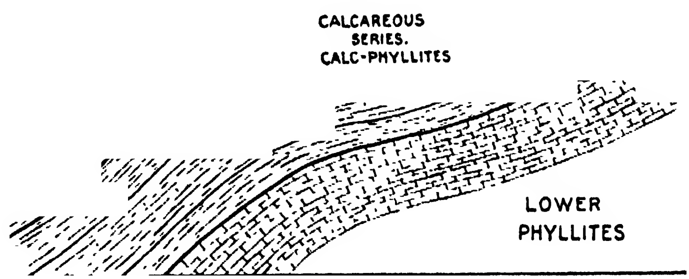


Fig. 2.

Section of the Glen Osmond Slates, showing the variation in character and dip. Length of section, 750 yards.

along the side of the hill and finally ends when the road turns north. The typical Glen Osmond quartzite does not occur here, but the section ends in a silty rock which immediately underlies the quartzite on the south side of the road. This spot is at the same height and on the same line of strike as similar beds on the south side of the valley. The contact between the phyllites and the quartzites can be seen in the Unley Corporation quarry and on the hillside east of the quarry. The quartzite which is more or less flat bedded in the floor of the quarry, changes

rapidly, till on the east face of the quarry the bedding is almost vertical. A hundred feet higher, and to the east, they are dipping to the east at an angle of 30°. Traced eastward they become horizontal and again dip westward, and finally become vertical and pass out of the top of the ridge. The beds immediately below the main quartzite are silty and soft sandstones. The phyllites between the Blue Metal and the quartzites exhibit a sequence. The beds just above the Blue Metal are calcareous-phyllites with a few interbedded thin limestones. These semi-calcareous beds occupy 440 feet above the Blue Metal. Above these come 370 feet of argillaceous rocks without the thin limestones. Then follows 670 feet of silty rocks, which suggest a gradual development of the conditions which lead to the quartzite.

The beds below the Blue Metal are cut off by the fault. The beds above the Thick Quartzite have been mapped in between the Thick Quartzite and the fault line. The junction of the Upper Phyllites and the Thick Quartzite is very disturbed, and it is possible that faulting has occurred along the junction in the Waterfall Gully area. The beds, as they approach the Waterfall from the west, become folded to the east, and on the south side just below the fall can be seen to be dipping at a high angle to the east. The Waterfall Gully runs approximately parallel to the strike of the beds, so that a traverse along it shows very little. High up on the north side of the gully is a quartzite with which is associated a blue limestone. This same bed can be seen, with its associated limestone, at a much lower level on the south-west side of the road. It is well seen just above the pump house that pumps the water up to Mount Osmond Golf Course. A hundred feet above this comes another quartzite, associated with a thin cream-coloured dolomite. (Howchin, *op. cit.*, p. 241.) This quartzite runs from the fault line at Beaumont in a south-easterly direction, parallel with the road, and gradually rising up the ridge until it passes over the top of the ridge and works back into Leawood Gardens on the south side of the ridge.

The Blue Metal was examined in places outside the area mapped. It was thought that it might be possible to link up the outcrop of Blue Metal in the Brownhill Creek with that at Glen Osmond. However, a brief examination of the beds showed that the direction of dip had changed from S.75°W. at Burnside to S.E. in the Brownhill Creek. This indicates a break in the tectonics between the two areas. The Brownhill Creek area cannot be treated as an extension of that at Burnside, but presents a problem of its own. The boundary of the two blocks is probably not far south of the southern edge of the area mapped in. The succession of beds in the Blue Metal series in this locality is similar to that at Beaumont. Commencing with a thick limestone 20 feet thick, there are over 300 feet of calcareous series containing in all 50 feet of limestone.

The Blue Metal was examined in the Stonyfell area. Here the beds are disturbed, being folded and faulted, and it is impossible without much detailed work to do more than repeat what Professor Howchin has said of this area (*op. cit.*, p. 238). Here, too, the relationship between the Blue Metal and the Thick Quartzite cannot be observed, as there is a major fault line which cuts off the Thick Quartzite in the western side of Dunstan's Stonyfell quarry and has let down the Blue Metal Limestone, which is about 1,000 feet above the top of the Thick Quartzite, level with the base of the Thick Quartzite. This fault is thus of a large order of magnitude. Professor Howchin noticed this fault (*op. cit.*, p. 243), but apparently did not record its significance with regard to the Blue Metal.

Petrography.

The Blue Metal limestone is a hard dark blue rock with an imperfect conchoidal fracture. It is very fine grained, no crystals being visible to the naked eye except occasional crystals of black dolomite. At some horizons the beds contain

nodules of chert, and there may be a thin layer of chert above a bed. Under the microscope the rock is seen to consist of a mass of small subidiomorphic crystals of dolomite with irregular aggregates of quartz. The dolomite crystals are very even in size, ·006—·007 mm. The quartz is in relatively large flaky areas which have recrystallized to grains about ·025 mm. These aggregates have not the clear cut edges which would result if they had simply been recrystallized adventitious grains of quartz, but are intergrown with the dolomite crystals in such a way as to suggest precipitation as colloidal silica, or as opal by radiolaria, and recrystallization simultaneous with the dolomitisation of the rock. The other constituents are pyrites and haematite and muscovite. The mica is in very small flakes.

A complete analysis of the Blue Metal limestone from the main band at Beaumont was carried out by one of the writers (T. A. B.) with the following results:—

SiO_2	28·15	Alkalies	0·89
TiO_2	·10	CO_2	31·95
Al_2O_3	1·13	P_2O_5	0·13
Fe_2O_3	0·54	H_2O+	0·01
FeO	0·34	H_2O-	0·13
MnO	0·01	FeS_2	1·22
CaO	21·18		
MgO	14·54	Total	100·32

In addition the following partial analyses were made:—

No.	13	3A	8	2	9	17	U.T.L.	L.T.L.
SiO_2	27·5	27·6	24·7	22·0	5·1	30·1	24·9	29·0
Al_2O_3, etc.	3·4	3·0	2·7	3·4	3·5	5·7	3·3	2·4
CaO	21·7	22·9	23·9	24·5	44·8	19·1	21·8	20·1
MgO	14·7	15·1	15·4	16·2	6·1	13·9	17·0	16·3
CO_2	33·1	32·1	33·4	n.d.	39·9	31·9	33·2	32·2
	100·4	100·7	100·1	——	99·4	100·7	100·2	100·0

13 Quarry 200 yards N.70E. of Mountain Hut.—Analyst, T. A. B.

3A Quarry 350 yards south of Devil's Elbow.—Analyst, T. A. B.

8 Quarry on creek north of Goldsack's Quarry.—Analyst, T. A. B.

2 Big quarry 200 yards up Mount Barker Road from Devil's Elbow. —Analyst, A. W. K.

9 Limestone outcrop, 1,200 yards S.10°W. of Goldsack's Quarries.—Analyst, T. A. B.

17 Limestone interbedded with slates near spot B on map.—Analyst, T. A. B.

UTL Upper Torrens limestone—Torrens Gorge, near Sixth Creek.—Analyst, T. A. B.

LTL Lower Torrens limestone—Torrens Gorge, near Deep Creek.—Analyst, T. A. B.

These analyses show remarkable similarity between the main Blue Metal Limestone over the whole area. The high silica percentage occurs as free quartz in the slide. The carbonate portion is purely dolomite; thus the rocks would be more truly classed as dolomites. The inclusions of the analyses of the two Torrens limestones is for comparative purposes. It was thought that some distinction might be made between the Blue Metal and Upper Torrens Limestones on chemical grounds. There seem to be no essential differences, the higher percentage of magnesia in the Upper Torrens limestone being due to weathering, which in these areas tends towards the formation of magnesite. Nos. 9 and 17 are representative of the upper beds above the Blue Metal Series. No. 17 is quite regular, except for a greater percentage of clay. No. 9 is composed entirely of large

crystals of black calcite with curved crystal faces which give an unusual appearance in hand specimen. It forms an inconstant band.

The tectonics of this small area are intimately bound up with the large scale movements which built up the Mount Lofty Ranges, and cannot be fully explained until much more is known of the structure of these ranges. The north-western and western boundary of the area is a natural one, an important fault scarp bounding the ranges there, possibly the western fault of the Belair Block (Fenner, Proc. Roy. Soc. S.A., vol. li., 1927, p. 217, *et seq.).* The northern boundary is quite arbitrary, and the area to the northward is the natural extension of this area. The southern boundary marks the beginning of an important break in the structure of the ranges. The eastern boundary is the thick quartzite which extends eastward to Mount Lofty. This boundary is also a junction plane of some complexity. The dominant feature of the area is the fault which runs across the area and cuts it into two separate parts, which must be considered separately. No idea could be gained of its magnitude, as no one bed can be seen on both sides of the fault. West of the fault the beds immediately associated with the blue metal have a dip of 26° in direction S.75°W. The higher beds, as they come nearer to the Mitcham Quartzites, roll and pass under the quartzites in step-like folds, with the downthrow to the west. The beds on the eastern side of the fault are of fairly uniform dip, 20°-25° in direction S.80°W., but as they pass toward the disturbed area they flatten and then dip east at a high angle.

The folding and faulting of the area appears to be, in part, very ancient, and is possibly of Cambrian Age. The area had then been eroded to a peneplain before the Tertiary uplift and block faulting. Thus the topography is of a complex nature. The longer streams are antecedent streams modified by the uplift, and the smaller ones are subsequent, draining the edge of the fault scarp.

The Blue Metal Limestone has been mapped in a type locality and shown to occupy a broad zone of 370 feet of calcareous series, of which 49 feet is blue metal. The limestone is chemically a dolomite. Above the Blue Metal Series is 1,500 feet of the Glen Osmond Clay Slates, which underlie in turn the Glen Osmond and Mitcham Quartzites.

A PRELIMINARY ACCOUNT OF THE COLLEMBOLA-ARTHROPLEONA OF AUSTRALIA.

PART II.—SUPERFAMILY ENTOMOBRYOIDEA.

By H. WOMERSLEY, A.L.S., F.R.E.S. (Entomologist, South Australian Museum).

[Read August 9, 1934.]

As with the Poduroidea, this superfamily of the Collembola has been little studied in Australia, doubtlessly because of its apparent lack of economic importance. That some species, at least, are potential pests will be seen from the few cases mentioned later.

The first record of this group from this country is that of *Isotoma troglodytica (Proisotoma minuta* Tullberg), described by Rainbow in 1907 (26). The remainder of the hitherto known forms were those recorded or described by Schött (28) from the Mjöberg material. In this collection were 33 species.

In the present paper, 78 species are recorded (3 as varieties only), of which 31 species are new, and no fewer than 27 are well-known forms, previously unknown from Australia. Three new genera are described.

Although even now the Collembolan fauna of Australia can be but partly known, especially in the northern parts, the numbers of species in the three main divisions are as follows:—

Symphypleona - - - -	- 47
Arthropleona-Poduroidea -	- 33
,, Entomobryoidea	- 91
	171

This total is only a little less than that of the species known for Europe.

Economic Importance of the Entomobryoidea.

Although the economic importance of the Collembola is as yet very little realized, except in one or two cases, the list of injurious species is gradually growing. In a recent publication Folsom (110A) has listed 43 species definitely injurious to crops. Of these, 16 belong to the group discussed in this paper, and 7 of them are now known to occur in Australia.

During the past few decades, there has been a tendency on the part of those who provide the money for research to ignore the pure collector and systematist and to concentrate only on the economic aspect. The fact that many species of Collembola present in Australia are either native of, or at least occur in, the more settled countries, should emphasise the importance and need for a thorough systematic and faunistic study of all insect orders. Hitherto, owing to the lack of this knowledge, much valuable time has been lost and money needlessly spent before the identity of a pest has been decided and its native country ascertained. Especially is this important in that field of entomological research known as Biological Control. Only in the native home of a pest can one hope to find controlling agencies, and many cases could be mentioned where, had a detailed faunistic knowledge been available, the obtaining of suitable parasites or predators would not have been such a blind and prolonged procedure.

[Part I. of this work was published in the Proceedings of the Royal Society of South Australia, vol. lvii., 1933, pp. 48-71. Note also "A preliminary account of the Collembola-Symphypleona of Australia," by the same author, C.S.I.R. pamphlet 34, 1932.—ED.]

The "Lucerne Flea," although known to occur in Australia since 1884, was not definitely determined as the *Sminthurus viridis* of Europe until recent years. Its predatory enemy, *Biscirus lapidarius,* a European species, was found to be a controlling agent first in Western Australia. The group of mites (Bdellidae) to which it belongs has only recently been systematically surveyed in Europe, and not at all in England. The knowledge derived from a proper regional survey of this group of mites in those countries would have enabled the economic entomologist to consider the use of this mite as soon as the necessity of a control of a biological nature became apparent.

In Hawaii two outstanding examples may be mentioned. The native country of the Sugar-cane Leaf-hopper, *Perkinsiella saccharicida* was unknown for some years after it had become a pest. Subsequently, after a long and blind search, it was discovered in Queensland, where it was controlled by a number of small wasps. These parasites were then introduced with success into Hawaii. A knowledge of the Homoptera fauna of Australia would, therefore, have saved time and money. Similarly, search for the native home of the Sugar-cane borer beetle *Rhabdocnemis obscura,* was made in many parts of the world before it was finally located in Amboina along with its parasitic Tachinid flies. The protracted studies in Mexico of the insect enemies of the Prickly Pear by Prof. Johnston and his successors might have been available before the plant had reached the pest stage in Australia.

These few examples will serve to emphasise my contention that the systematic study of the insect fauna of all countries, while necessarily coincident with economic studies, is essentially fundamental to the work of the economic entomologist. The tendency to ignore the systematist must give way and a proper perspective taken of his work as it affects the practical control of insect pests.

Superfamily ENTOMOBRYOIDEA.

= Entomobryomorpha Börner, 1913.

Family ISOTOMIDAE (Schäffer, 1898; Börner, 1913).

Subfamily ISOTOMINAE (Schäffer, 1898; Börner, 1913).

Tribe ANUROPHORINI Börner, 1906.

Genus CRYPTOPYGUS Willem, 1902.

This genus is essentially a primitive one, which, except for a single species from New Zealand, was hitherto known only from the Subantarctic Regions. The species are very close and can only be separated by minute characters such as the number of ocelli, the form of the postantennal organ and the structure of the mucrones. Two species are now described from Australia, and a key given for all known forms.

Cryptopygus australis, n. sp. (Text fig. 1, *a-f*.)

Description.—Length 0·7 mm. Colour, light-brown, mottled, with well separated darker spots. Antennae very little longer than the head, segments I. : II. : III. : IV. = 10 : 11 : 11 : 21, IV. with small eversible apical lobe. Antennal organ III. as in figure 1 *b*. Ocelli, 8 on each side on deeply pigmented patches. Postantennal organ broadly oval, two and a half times as long as an anterior ocellus. Relative lengths of body segments in medio-dorsal line = th. II. : III. : abd. I. : II. : III. : IV. : V. = 35 : 25 : 25 : 25 : 25 : 16 : 15, abdomen VI. hidden under V. Claws simple, without inner teeth. Empodial appendage with inner and outer narrow lamellae. Tibiotarsus with two fine clavate hairs. Furca short, ratio of dens to mucro = 4 : 1, dens broad and thick, mucro apically tridentate. Clothing consisting of short fine setae.

Locality.—You Yang Mountains, Victoria, collected by Miss J. W. Raff.

Type in the South Australian Museum.

Cryptopygus loftyensis, n. sp. (Text fig. 1, *i.-m.*)

Description.—Colour, entirely blue. Antennae slightly longer than the head, ratio of segments = 17 : 25 : 23 : 37, IV. with small terminal exsertile knob, organ III. normal. Ocelli, 8 on each side, equal, on dark patches. Postantennal organ elliptical, equal to two ocelli. Ratio of body segments along medio-dorsal line = th. II. : III. : abd. I. : II. : III. : IV. : V. = 40 : 40 : 25 : 30 : 32 : 46 : 30; VI. hidden under V. Claws with inner tooth slightly beyond the middle. Empodial appendage with broad inner lamella. Tibiotarsus with two fine clavate hairs. Furca longer than in preceding species, ratio of manubrium : dens : mucro = 30 : 23 : 7, dens tapering, mucro with apical and subapical teeth and narrow inner lamella. Clothing of simple setae, uniform, more numerous than in preceding species.

Localities.—Syntypes in moss, Mount Osmond, South Australia, June 9, 1934 (H. W.); others in moss, Mount Barker, South Australia, June 24, 1934 (H. W.).

Syntypes in South Australian Museum.

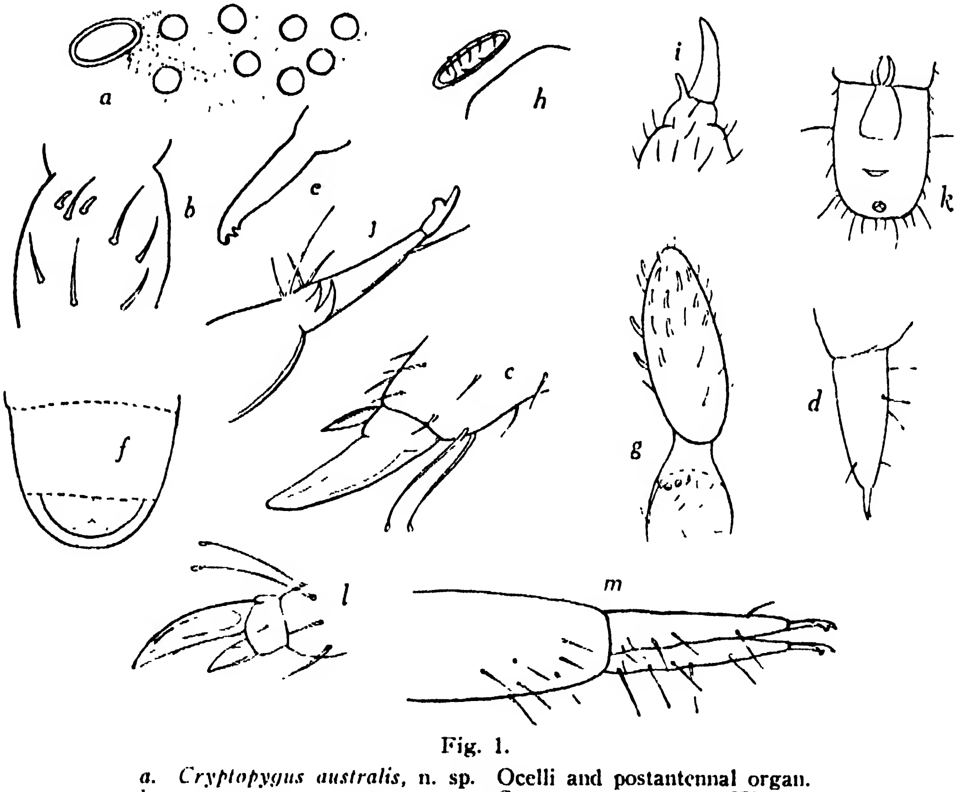


Fig. 1.

a. *Cryptopygus australis*, n. sp. Ocelli and postantennal organ.
b. „ „ „ „ Sensory organ on ant. III.
c. Tip of tibiotarsus.
d. Furca from side.
e. Mucro enlarged.
f. Apical abdomen segments from below.
g. *Isotomodes productus* (Axels.) Tip. of ant. III. and whole of IV.
h. Postantennal organ.
i. Tip of tibiotarsus and claw.
j. Furca.
k. „ „ „ Apical abdom. segments from below.
l. *Cryptopygus loftyensis*, n. sp. Tip of tibiotarsus and claw.
m. „ „ „ „ Furca.

Key to the Known Species of Cryptopygus Willem.

1. Ocelli, fewer than 8 on each side. P.a.o. crescentic or elliptical. 3
   Ocelli, 8 on each side. P.a.o., oval. 2
2. Mucro with three subapical teeth. P.a.o. three to four times as long as an anterior ocellus. *C. australis*, n. sp.
   Mucro with subapical and apical teeth only. *C. loftyensis*, n. sp.
   Mucro with only a blunt apical tooth. *C. niger* Carp, 1925 (New Zealand).
3. Ocelli absent. Mucro tridentate, distal tooth about the middle. Tibio-tarsus without clavate hairs. Colour, white. *C. caecus* Wahlgren, 1906 (Subantarctic).
   Ocelli, 6 or 7 on each side. 4
4. Ocelli, 7 on each side. P.a.o., crescentic. Clavate tibiotarsal hairs present. Mucro, bidentate. Colour, blackish. *C. antarcticus* Willem, 1902 (Subantarctic).
   Ocelli, 6 on each side. 5
5. Clavate tibiotarsal hairs absent. Colour, mottled bluish-black. *C. cinctus* Wahlgren, 1906 (Subantarctic).
   Clavate tibiotarsal hairs present. Colour, bluish-violet. *C. crassus* Carp., 1905-6 (South Orkneys).

Genus Isotomodes (Axels.) Linnaniemi, 1907.

Syn. *Isotoma* Axels. 1903 (ad partem).

Isotomodes productus (Axels., 1907). (Text fig. 1, *g.-k.*)

= *Isotomo elongata* Axels., 1903 (nec. McGillivray, 1896); *Isotoma producta* Axels., 1906; *Isotomodes productus* Axels., 1907.

Description.—Length, to 1·0 mm. White. Antennae short, about one-fourth as long as the head. Body elongate, ratio of abdominal segments = 4 : 6 : 5 : 6 : 6 : 4. Antennae IV. with subapical papilla and 6 olfactory hairs. P.a.o. large, broadly elliptical and not notched. Ocelli absent. Furca short, not reaching abd. II. Dentes not annulated, with 2 dorsal and 2 ventral setae. Mucro one-fourth the length of dens and with two strong teeth. Clothing short and sparse, simple.

Localities.—Under deeply embedded stones at Chittering, Western Australia, October 10, 1931 (H. W.); similarly on Mount Osmond, South Australia, in 1933 (H. W.).

Remarks.—This is a well-known but rare European species, and may possibly be considered as an introduction to Australia by means of plant soil.

Genus Folsomia Willem, 1902.

Syn. *Isotoma* Tullberg, 1897 (ad partem).

Folsomia fimetaria (Linn., 1758), Tullbg., 1872. (Text fig. 2, *a.*)

= *Podura fimetaria* Linn., 1758; *Isotoma alba* Tullbg., 1871; *Folsomia candida* Willem, 1902; *Isotoma splendens* Becker, 1902.

Description.—Length, 1·0-1·5 mm. Colourless and blind. Clothing of short, thick hairs. Antennae slightly longer than the head. Antennae IV. with subapical papilla and olfactory hairs. Antennal organ III. with 2 curved sensory rods and 2 guard setae. P.a.o. long and narrow with parallel edges, not curved. Claws unarmed, seldom with inner tooth. Empodial appendage lanceolate.

Clavate tibiotarsal hairs absent. Mucro as long as hind claw, with two teeth, one distal and one apical.

Locality.—Riddell, Victoria, on March 14, 1931 (H. G. A. and H. F. D.).

Remarks.—Probably an introduction from Europe, where it is a common species under loose boards, stones or in soil. It is also recorded from the Nearctic Region, and will probably be found to be widely distributed in cultivated parts of Australia.

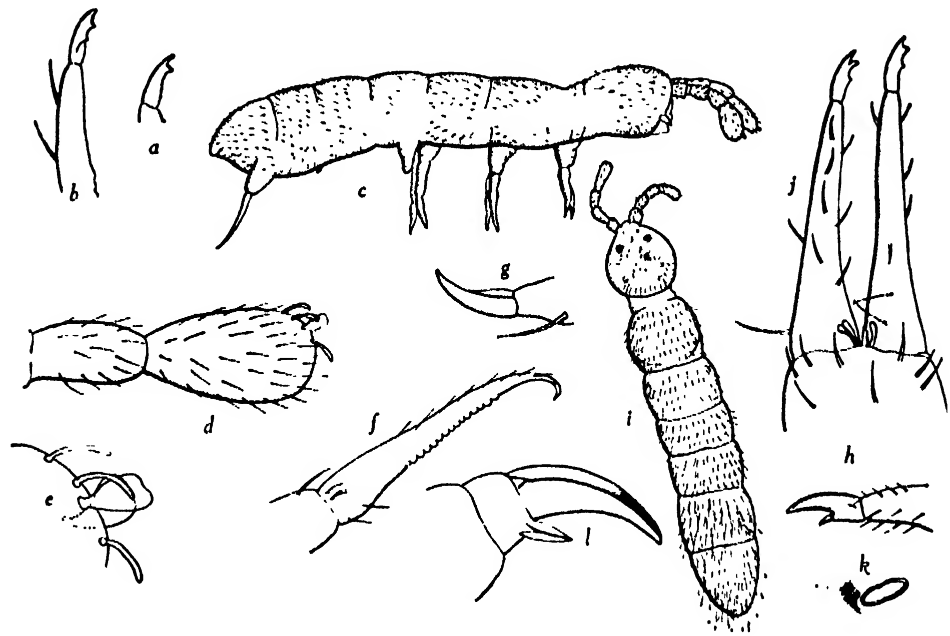


Fig. 2.

a.	*Folsomia fimetaria* (Linn.)	Mucro, side view.
b.	„ *fimetarioides* (Axels.)	Tip of dens and mucro.
c.	*Folsomina onychiurina* Denis	Entire animal.
d.	„ „ „	Ant. III. and IV.
e.	„ „ „	Sensory organ on ant. IV.
f.	„ „ „	Dens and mucro.
g.	„ „ „	Mucro.
h.	„ „ „	Tip of tibiotarsus and claw.
i.	*Folsomia loftyensis,* n. sp.	Entire animal, dorsal view.
j.	„ „ „ „	Furca.
k.	„ „ „ „	Ocelli and p. a. o.
l.	„ „ „ „	Foot.

FOLSOMIA FIMETAROIDES (Axels., 1903). (Text fig. 2, *b.*)

= *Isotoma fimetaroides* Axels., 1903.

Description.—Length, 1·8 mm. White and blind. Antennae as long as head, IV. with 10 olfactory hairs, subapical papilla and terminal knob. P.a.o. narrow and doubly contoured. Claws unarmed. No clavate tibiotarsal hairs. Abd. IV.-VI. fused. Furca not quite reaching ventral tube. Dens twice as long as manubrium, distally curved and annulated. Mucro with three teeth.

Localities.—Sherbrook, Victoria, April 19, 1931 (H. G. A. and H. F. D.); September, 1931 (H. F. D.); Sassafras, Victoria, December, 1931 (H. G. A.).

Remarks.—This species differs little from the preceding except in the dentition of the mucro. It is also possibly an introduction from Europe, where it has been recorded from Finland, Switzerland, and England.

Folsomia loftyensis, n. sp. (Text fig. 2, *i.-l.*)

Description.—Length to 1·5 mm. Colour, whitish-grey, with slight patches of dark pigment on head and laterally on body. Ocelli, 3 on each side close together in a triangle, deeply pigmented on small dark patches. Post-antennal organ large, quite three times as long as the whole ocellar patch, doubly contoured and notched on each side. Antennae slightly longer than head, ratio of segments = 12 : 18 : 18 : 32, IV. with terminal knob, antennal organ III. indeterminate. Thorax II. and III. subequal. Abdomen IV. slightly longer dorsally than III. Claws simple, unarmed. Empodial appendage with inner and outer lamellae. Furca short, not reaching abd. II.; ratio of dens to mucro = 5½ : 1; mucro tridentate (*cf.* fig.); dentes ventrally with spines. Abdomen IV.-VI. fused. Anus slightly ventral. Clothing of long fine setae.

Locality.—Long Gully, Mount Lofty Ranges, South Australia, May, 1934 (H. W.).

Syntypes in the South Australian Museum.

Remarks.—Differs from *Folsomia sexoculata* Tullbg. in the arrangement of ocelli and the tridentate mucro.

Genus Folsomina Denis, 1932.

This very interesting genus is closely allied to *Folsomia* Willem, but differs in the falciform mucro, the absence of a postantennal organ and in the complicated structure of the subapical sensory organ on the fourth antennal segment.

Folsomina onychurina Denis, 1932. (Text fig. 2, *c.-h.*)

Description.—Length, 0·6-0·7 mm. Colour, white. Ocelli and p.a.o. wanting. Antennae slightly longer than the head, ratio of lengths of antennal segments = 8 : 10 : 12 : 20, IV. twice as broad as III., subapically with a complex sensory organ consisting of two large scale-like lobes, behind which are two strongly curved olfactory hairs and in front another one. Antennal organ III. consisting of two rods or tubercles flanked by two olfactory hairs. Claws unarmed, five times as long as mucro. Empodial appendage distinct with narrow outer and broader inner lamella. Clavate tibiotarsal hairs absent. Furca rather short, ratio of manubrium to mucrodens = 17·5 : 30, dens tapering and annulated, mucro falciform with a slight inner basal lamella. Clothing of short, sparse, simple setae.

Localities.—Nangara, Western Australia, November 11, 1930 (B. A. O'C.); in hothouse, Government Gardens, Perth, Western Australia, February 10, 1930 (B. A. O'C.).

Remarks.—This genus and species was only described in 1932 from two specimens collected in Costa Rica in 1911. Its occurrence in Australia is remarkable, and while its capture in a hothouse may point to its being an introduction, the Nangara locality may be a perfectly natural one. No details of the habitat in which it occurred in Costa Rica are given.

Genus AXELSONIA Börner, 1907.

Syn. *Isotoma* Moniez, 1890 (ad partem).

AXELSONIA LITTORALIS (Moniez, 1890). (Text fig. 3, *a.-e.*)

= *Isotoma littoralis* Moniez, 1890; *Isotoma nitida* Folsom, 1899; *Axelsonia thalassophila* Börner, 1906; *Axelsonia littoralis* Denis, 1924.

This is a typical shore-inhabiting form and lives on decaying molluscs and barnacles. It is to be found in numbers in the crevices of rocks lying between high and low water, and can withstand immersion to a considerable depth. Previously it has been recorded from France, Japan and the Seychelles. The genus, which is monotypic, is separated from the other genera of the Isotominae on the following characters: abdomen II.-IV. with 2 pairs of fine sensory setae (Bothriotrichiae). P.a.o. absent. Clavate tibiotarsal hairs absent. Claw on outside with two long lancet-like processes. Antennae III. with 15-20 sensory rods. Colour, greyish-green.

In Australia this species has been found in the following localities:—Longreach Bay, Rottnest Island, Western Australia, January, 1931 (L. J. G.); Point Perron, Western Australia, April 6, 1931 (H. W.); King River Estuary, Western Australia, January, 1932 (H. W.).

Genus **Acanthomurus**, n. gen.

Allied to *Isotomurus*, but differing in that the dentes are armed ventrally with numerous slightly curved setae which are strongly serrated on one side. The body setae are strongly ciliated and not simple.

Genotype = *Acanthomurus plumbeus*, n. sp.

Acanthomurus plumbeus, n. sp. (Text fig. 3, *f.-j.*)

Description.—Length, 2·7 mm. Colour, blue-black, except anterior margins of segments, which are yellowish. Antennae and legs, except trochanters and base of femora, blue-black. Furca, yellowish with a tinge of blue at base of manubrium. Antennae nearly three times as long as head; ratio of segments = 1 : 4 : 4 : 4¼. Ocelli, 6 on each side on dark patches. P.a.o. small, elliptical, less than half an ocellus in diameter. Antennal organ III. as in figure 3, *g*. Legs long; claws with two inner teeth, one slightly beyond the middle, the other more distal, and a basal lateral tooth. Empodial appendage long, reaching past the first tooth of the claw, with broad outer lamella reaching the tip and slightly narrower lamella on inside for one-third of its length; the latter lamella with a very prominent inner tooth. Clavate tibiotarsal hairs absent. Furca reaching ventral tube; ratio of manubrium to mucrodens = 1 : 2½, mucro less than one-fourth the length of hind claw and with four teeth. Dentes indistinctly fringed with numerous long hairs and on ventral side with short and strong, evenly curved, setae, which are serrated on one side. Length of body segments, th. II. : III. : abd. I. : II. : III. : IV. : V. : VI. = 2½ : 2 : 1½ : 2 : 2¾ : 2½ : 1½ : 1. Segments of body heavily clothed with long ciliated setae. Abdomen IV. and VI.? with sensory setae (Bothriotrichiae), as well as several equally long but stouter ciliated setae. Tibiotarsi with long setae.

Localities.—Under rotten bark at Parkerville, Darling Ranges, Western Australia, October 5, 1930 (H. W.); Mount Barker, Western Australia, June, 1931 (H. G. A.); Gooseberry Hill, Western Australia, June, 1932 (G. E. N.).

Syntypes in the South Australian Museum.

Var. **lineatus**, n. var.

Differs from the typical form in the lighter ground colour and the four longitudinal dark lines on the dorsum. Specimens were received from Launceston, Tasmania, collected by Mr. V. V. Hickman in August, 1929.

Type in the South Australian Museum.

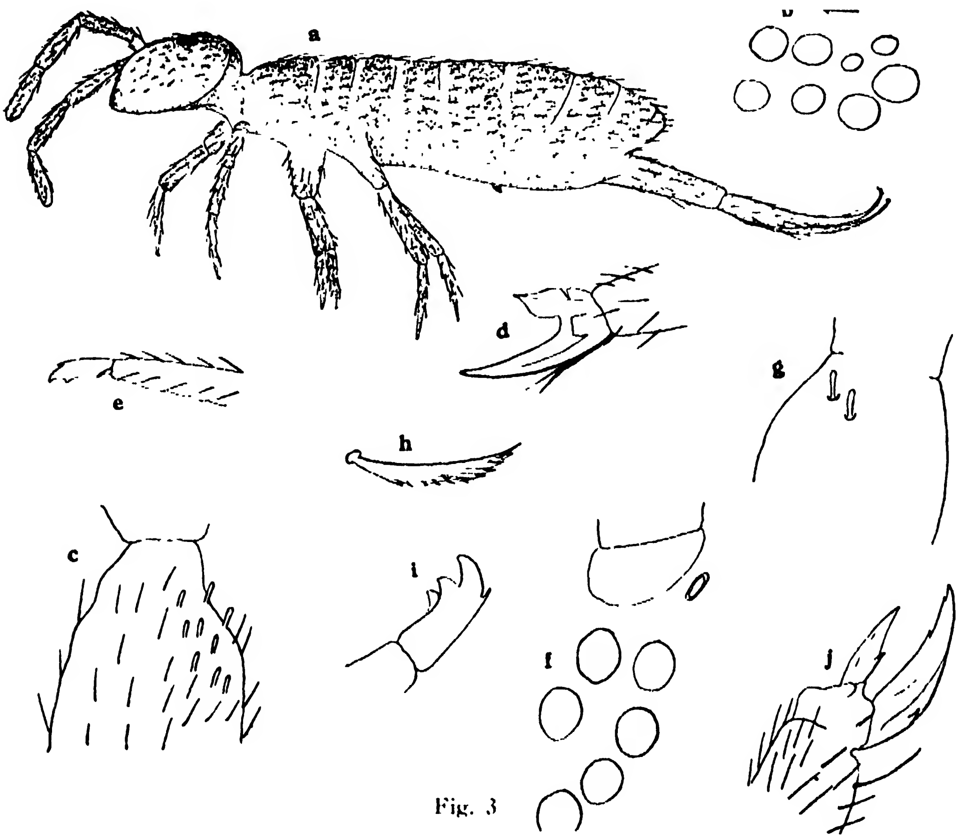


Fig. 3

a.	*Axelsonia littoralis* (Monz.)	Entire animal.
b.	„ „ „	Ocelli.
c.	„ „ „	Tip of ant. III.
d.	„ „ „	Tip of tibiotarsus and claw.
e.	„ „ „	Mucro and tip of dens.
f.	*Acanthomurus plumbeus*, n g., n. sp.	Ocelli and postantennal organ.
g.		Sensory organ on ant. III.
h.		Curved seta from ventral surface of dens.
i.		Mucro.
j.		Tip of tibiotarsus and claw.

Genus **Proisotomurus**, n. gen.

Allied to *Isotomurus* and *Acanthomurus* but having the dentes armed ventrally with a double row of strong, simple spines arising from very distinct papillae. These papillae would appear to connect the genus with *Agrenia* Börner. Fine sensory setae (Bothriotrichiae) are present on at least abdomen II. and III., but these are only about half as long as in the genera *Isotomurus* and *Acanthomurus*.

Genotype = *Proisotomurus papillatus*, n. sp.

Proisotomurus papillatus, n. sp. (Text fig. 4, *a-c.*)

Description.—Length, 2·6 mm. Colour as in *Isotomurus palustris* Mull., *f.p.* Antennae nearly $2\frac{1}{2}$ times the length of head, segments = $1\frac{1}{4} : 2 : 2 : 2\frac{1}{8}$. Antennal organ III. as in fig. 4 *a.* Ocelli, 8 on each side. P.a.o. small, elliptical about half an ocellus in diameter. Ratio of lengths of body segments = th. II. : III. : abd. I : II. : III. : IV. : V. : VI. = $1 : 1 : \frac{2}{3} : \frac{3}{4} : 1 : 1 : \frac{1}{2} : \frac{1}{2}$. Claws with basal lateral tooth but no inner teeth. Empodial appendage reaching to half the length of claw, pointed, with broad inner and narrower outer lamella, inner angle with small tooth. Clavate tibiotarsal hairs absent. Furca reaching beyond ventral tube; ratio of manubrium to mucrodens = $2\frac{1}{2} : 4\frac{1}{2}$. Dentes with moderately long setae and ventrally with two rows of papillae, each armed with a long, strong spine. Mucro with four teeth. Clothing of numerous long, simple setae, although several longer setae on the middle and hind legs are ciliated. Abdomen II.-IV with fine but relatively short sensory setae.

Locality.—Guildford, Western Australia, October 6, 1930 (H. W.).

Syntypes in the South Australian Museum.

Genus Isotomurus Börner, 1903.

Syn. *Podura* Müller 1776 (ad partem); *Isotoma* Bourlet, 1839 (ad partem).

Isotomurus palustris (Müller, 1776). (Text fig. 4, *f-g.*)

= *Podura palustris* Müller, 1776; *Isotoma palustris* Tullberg, 1872; Lubbock, 1873; Reuter, 1876 (ad partem); Reuter, 1880. *Isotoma aquatilis* Lubbock, 1873 (ad partem). *Isotoma stuxbergi* Tullberg, 1876; Moniez, 1891; Jacobson, 1898. *Isotomurus palustris* Börner, 1903. *Isotoma tricolor* Packard, 1873. *Isotoma aequalis* MacGillivray, 1902.

Description.—Length, to 3·0 mm. Thickly haired, but all hairs are simple except a few longer ones on segments V. and VI which are ciliated. Bothriotrichiae on abd. II.-IV. Colour very variable, from uniform yellowish-green to blackish, the lighter forms sometimes with longitudinal lines. Ocelli, 8 on each side. P.a.o. elliptical, as wide as two ocelli. Antennae half as long again as head. Claws long, without inner teeth. Empodial appendage lanceolate with lateral teeth and basally rounded inner lamella. Clavate tibiotarsal hairs absent. Dens twice as long as manubrium. Mucro with four teeth.

This cosmopolitan species is common everywhere on cultivated ground in the southern part of Western Australia, and also in South Australia Specimens have also been sent from Stanley, Tasmania, collected in 1930.

Var. Balteata (Reuter, 1876).

= *Isotoma balteata* Reuter, 1876; *Isotoma palustris* var. *balteata* Schött, 1893, Reuter, 1895.

This variety has the anterior three-fourths of the abdominal segments dorsally of a bluish colour. It occurred rather abundantly in the hot-house of Government Gardens, Perth, Western Australia, on February 11, 1932. I have also seen specimens collected by Mr. A. R. Brimblecombe in a glass-house at Brisbane, Queensland, May 16, 1932.

Isotomurus chiltoni (Carp., 1925). (Text fig. 4, *i.-m.*)

= *Isotoma chiltoni* Carp., 1925.

This species was described by Dr. Carpenter from a single, somewhat abraded specimen from New Zealand. Owing to the poor condition of the specimen the original description is lacking in many important details. I have received many

specimens from various parts of Australia which appear to be co-specific with Carpenter's species, and I am able to give a somewhat fuller description. Dr. Carpenter's surmise that the body hairs when present might be ciliated is confirmed. No mention was made in the original description of the postantennal organ, but in many of my specimens this was observed to be present although comparatively small and only seen with difficulty. Similarly, no sensory setae were observed originally on the New Zealand specimen, and they were therefore presumed to be absent. In most of my specimens these setae were distinctly present. The presence of the latter places the species in *Isotomurus* and not *Isotoma.*

Fig. 4.

a.	*Proisotomurus papillatus,* n. g., n. sp.	Tip of ant. III.
b.		Anterior ocellus and postantennal organ.
c.		Claw and tip of tibiotarsus.
d.		Mucro and tip of dens.
e.		Abdominal sensory hair.
f.	*Isotomurus palustris* (Müll.)	Claw and tip of tibiotarsus.
g.	,, ,, ,,	Mucro and tip of dens.
h.	*Isotoma tridentifera* v. *edenticulata,* n. v.	Claw and tip of tibiotarsus.
i.	*Isotomurus chiltoni* (Carp.)	Antennae.
j.	,, ,, ,,	Anterior ocelli and postantennal organ.
k.	,, ,, ,,	Claw and tip of tibiotarsus.
l.	,, ,, ,,	Mucro and tip of dens.
m.	,, ,, ,,	Dorsal body hairs.
n.	*Isotomurus echnidus,* n. sp.	Antennae II. showing specialized setae of male.
o.	,, ,, ,,	Specialized setae of ant. II. of male.
p.	,, ,, ,,	Claws and empodial appendage of leg III.
q.	,, ,, ,,	Claws and empodial appendage of leg I.
r.	,, ,, ,,	Mucro.

Amended Description.—Size, to 3·0 mm. Colour, variable, from yellowish with dark purple marking to almost completely bluish. Antennae twice as long as head, ratio of segments approximately 15 : 20 : 20 : 30. Ocelli, 8 on each side on dark patches, inner hinder pair of ocelli smaller than the others. P.a.o. present, small, elliptical, half as long as an anterior ocellus. Claws with prominent dorsolateral teeth and two fine inner teeth (one, in Carpenter's specimen).

Empodial appendage elongate with narrow outer lamella and broader basal inner lamella with an acute spine at the angle. Mucro with small ventral tooth and prominent apical tooth, as well as two dorsal teeth. Clothing of comparatively long and numerous, strongly ciliated setae, which are longer and stouter on the anal segments and on the head. In addition, sensory setae are present on abdomen II.-IV.

Localities.—Crawley, Western Australia, June 3, 1931 (D. C. S.); National Park, Western Australia, September 3, 1931 (D. C. S.); Sherbrook, Victoria, April 19, 1931 (H. F. D. and H. G. A.); Pinjarra, Western Australia, September 29, 1931 (D. C. S.); Adelaide, South Australia, April 7, 1932 (D. C. S.); Gooseberry Hill, Western Australia, June 6, 1932 (G. E. N.); Armadale, Western Australia, June, 1932 (G. E. N.); Albany, Western Australia, July 7, 1932 (H. W.); Porongorups, Western Australia, September 30, 1932 (H. W.).

Isotomurus echidnus, n. sp. (Text fig. 4, *n-r.*)

Description.—Length, 3·2 mm. Colour, bluish with dark posterior edges to the segments and a slight dorsal streak. Antennae bluish, II.-IV. lighter except apex of IV. Legs and manubrium bluish. Ocelli, 8 on each side, equal. P.a.o. present, half an ocellus in diameter, elliptical. Antennae two and a half times as long as the head, ratio of segments = 15 : 20 : 20 : 30, clothed with numerous short ciliated hairs between which are similar but simple spines. Claws approximately three times as long as mucro, with three very fine distal teeth inside. Empodial appendage about one-half the length of claw, with fine outer distal tooth on leg III.; shorter and without tooth on leg I. Clavate tibiotarsal hairs absent. Furca strong, reaching ventral tube, ratio of manubrium to mucrodens = 35 : 42, mucro with only two teeth. Clothing of numerous very short, curved, ciliated setae; around the neck, on head and dorsally on segments with many long stout parallel-sided, rather blunt ciliated setae. On the middle of abdomen III. in good specimens is a beard-like cluster of curved ciliated setae of intermediate length. Sensory setae are present at least on abdomen II.-IV. Ratio of th. II. : III. : abd. I. : II. : III. : IV. : V. : VI. = 25 : 15 : 10 : 20 : 20 : 35 : 10 : 5. The male sex is remarkable for the presence, on the apical inner side of segment II. of the antennae, of a cluster of short strong and, in certain aspects, apically broadened and ciliated setae or spines.

Localities.—Holotype female and one other from Trevallyn, Tasmania, August 17, 1929 (V. V. H.); allotype male from Bridgewater, South Australia, June 6, 1932 (D. C. S.); Glen Osmond, South Australia, May 14, 1933 (H. W.); in numbers in moss, Waterfall Gully, South Australia, September, 1933 (H. W.).

Key to the Australian Species of Isotomurus.

1. Mucro with four teeth. *2*
   Mucro with only two teeth. Some of the body setae large, parallel-sided and ciliated. Male with specialized setae on antennae II. *I. echidnus*, n. sp.
2. Most of the body setae simple, only a few ciliated ones on anal segments. P.a.o. large. *I. palustris* (Müller).
   All body setae ciliated, the larger ones always pointed apically. P.a.o., small. *I. chiltoni* (Carp.).

Genus Proisotoma Börner, 1906.

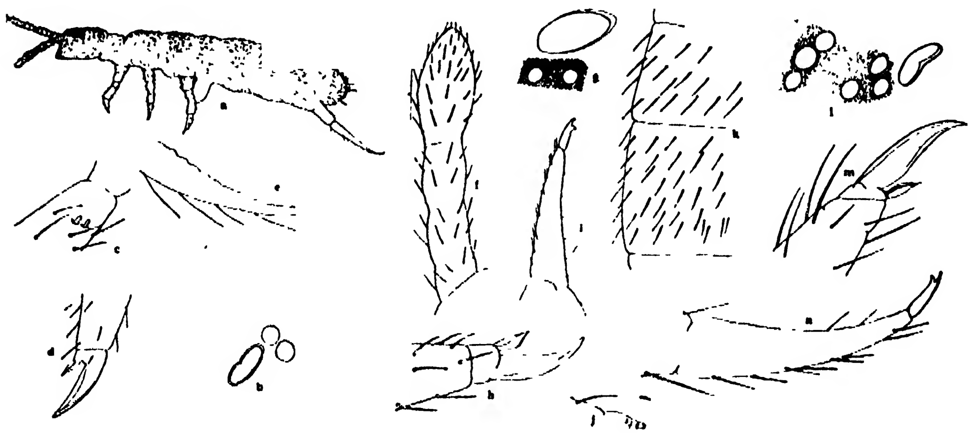
Syn.—*Isotoma* Tullberg, 1871 (ad partem).
Proisotoma Börner, 1901 (ad partem) (as subgenus).

Subgenus Isotomina Börner, 1903.

PROISOTOMA (ISOTOMINA) THERMOPHILA (Axels., 1907). (Text fig. 5, *a.c.*)

Description.—Length, 1·0 mm. Of general *Isotoma* facies, but abdomen IV. longer than III. Colour, greyish. All setae simple, rather longer on anal segments. Antennae indistinctly longer than the head, IV. without olfactory setae. P.a.o. elliptical, notched medially on each side, equal in length to 2-3 ocelli. Ocelli, 8 on each side, equal. Tarsi without clavate hairs. Abdomen V. and VI. fused. Furca scarcely reaching middle of abdomen II. Mucro with two teeth.

Numerous specimens which can be referred to this European species have been collected from the following localities:—Crawley, Western Australia, June 3, 1931 (D. C. S.); Gooseberry Hill, Western Australia, June 6, 1932 (G. E. N.); Bridgetown, Western Australia, June 16, 1932 (H. G. A.); Reedbeds, South Australia, May 4, 1933 (H. W.).



Proisotoma (Isot mina) thermophila (Axels.)	Entire animal.
	Anterior ocelli and postantennal organ.
	Tip of ant. III.
	Claw and empodial appendage.
	Mucro and tip of dens.
f. *Proisotoma ripicola* Linnan.	Antennae.
g. " " "	Anterior ocelli and postantennal organ.
	Claw and tip of tibiotarsus.
	Mucro and dens.
	Rami of tenaculum.
	Dorsal body setae.
l. *Proisotoma (Isotomina) sexoculata*, n. sp.	Ocelli and postantennal organ.
m. " " " "	Claw and tip of tibiotarsus.
n. " " " "	Mucro and dens.

Proisotoma (Isotomina) sexoculata, n. sp. (Text fig. 5, *l.-n.*)

Description.—Length, 1·0 mm. Colour, uniformly bluish. Antennae one-third longer than the head, ratio of segments = 10 : 15 : 15 : 25, antennal organ III. normal. P.a.o. two and a half times as long as an anterior ocellus. Ocelli, 6 on each side in two groups of three and on two patches of pigment which join, posterior group of ocelli unequal. Ratio of length of abdomen III. : IV. = 30 : 35, abdomen V. and VI fused. Claw with fine inner tooth. Tibiotarsus with two long indistinctively clavate hairs. Furca short and only just reaching abdomen II., ratio of manubrium : dens : mucro = 15 : 15 : 5; dens with 8 ventral and 2 subapical dorsal setae.

Localities.—Crawley, Western Australia, April, 1931 (D. C. S.); Sherbrook, Victoria, April, 1931 (H. F. D. & H. G. A.); ditto September, 1931 (H. F. D.); Sassafras, Victoria, December, 1931 (H. G. A.).

Syntypes in the South Australian Museum.

Remarks.—This species is closely related to *P. (I.) hirsuta* Denis from Costa Rica, but has a mucro very much smaller as compared with the dens.

Proisotoma (Isotomina) pilosa, n. sp. (Text fig. 6, *h.-j.*)

Description.—Length, 1·4 mm. Colour, bluish, darker on ocellar patches. Antennae barely longer than the head, ratio of segments = 1 : 1½ : 1½ : 2¼. IV. with terminal knob and ? one or two olfactory hairs, antennal organ III. as far as can be seen of normal structure. Ocelli, 6 on each side on a single patch of pigment. P.a.o. elliptical, equal to one anterior ocellus in diameter. Claws unarmed. Empodial appendage lanceolate. Clavate tibiotarsal hairs absent. Furca short, only reaching posterior edge of abdomen II. Mucrodens subequal to manubrium, mucro with two teeth, half the length of dens, dens with 3 ventral setae, the basal one longer than the others, and three short setae apically and dorsally, dentes not annulated. Manubrium ventrally with 7-8 setae. Rami with 4 barbs and basal seta. Abdomen III. : IV. = 4 : 4½, V. and VI. fused. Clothing of strong setae much as in *P. (I.) hirsuta* Denis; some longer on anal segments.

Locality.—In moss from Waterfall Gully, Mount Lofty Ranges, South Australia, May 6, 1933 (H. W.).

Syntypes in the South Australian Museum.

Remarks.—Like the preceding, this species is very close to *P. (I.) hirsuta* Den. from Costa Rica, but differs in the complete absence of clavate tibiotarsal hairs, the length of the p.a.o., the shape of the empodial appendage, the dental setae and the relative lengths of the mucro and dens.

Subgenus PROISOTOMA s. str. Börner, 1906.

PROISOTOMA RIPICOLA Linnaniemi, 1912. (Text fig. 5, *f.-k.*)

= ? *Isotoma agilis* Schtscherbakow, 1899; Axelson, 1905. *Proisotoma agilis* (Axels.) Linnaniemi, 1907.

Description.—Length, to 1·2 mm. Colour, greyish to dark violet. Antennae slightly longer than head. Antennae IV. with terminal knob, without olfactory hairs. P.a.o. elliptical, as long as 2-3 ocelli. Ocelli, 8 on each side, equal. Clavate tibiotarsal hairs absent. Claws large, unarmed. Empodial appendage scarcely half as long as claw and with narrow angular inner lamella. Abdomen IV.-VI. distinctly separated. Rami with 4 barbs and corpus tenaculi with 2-3 setae. Furca reaching middle of abdomen II. Manubrium thickly haired dorsally, with 2 unusually long, strong distal setae ventrally. Dentes annulated, with numerous short setae. Mucro plump with 2 teeth, of which the apical is decidedly the shorter. Clothing of short and equally long hairs.

This European species has been received from Nangarra, Western Australia, November 21, 1930 (B. A. O'C.); Gooseberry Hill, Western Australia, June 2, 1932 (G. E. N.); St. Ronan's Well, Western Australia, June 11, 1932 (G. E. N.).

PROISOTOMA SCHÖTTI (Dalla Torre, 1895). (Text fig. 6, *a-d.*)

= *Isotoma litoralis* Schött, 1893; *Isotoma schötti* Dalla Torre, 1895; *Isotoma lacustris* Schött, 1896.

Description.—Length, 2·0 mm. Colour, violet. Antennae only slightly longer than the head. Ocelli, 8 on each side. P.a.o. as long as a single ocellus. Empodial appendage with a very distinct apical bristle. Furca reaching ventral tube; dens without ventral setae, not tapering apically. Mucro with two teeth and distinct broad lamella. No clavate tibiotarsal hairs.

I have seen specimens of this common European species from the following localities:—Cannington, Western Australia, July 7, 1931 (H. W.); specimens in the South Australian Museum from Adelaide, without data; Perth, Western Australia, 1932 (H. W.); Woodside, South Australia, July, 1933 (H. W.).

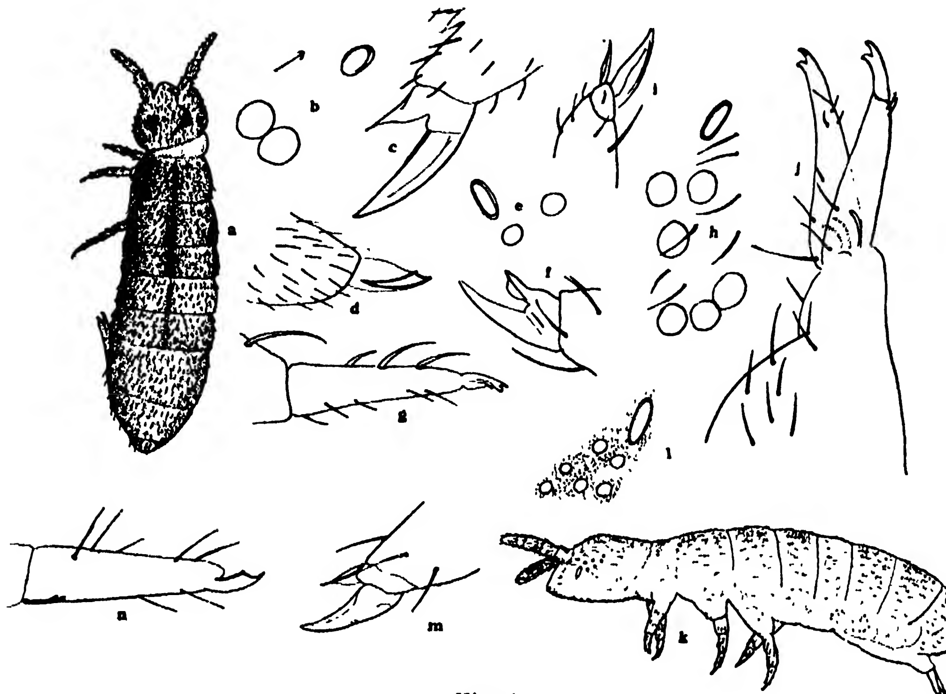


Fig. 6.

a.	*Proisotoma schötti* (Dalla Torre)	Entire animal.
b.	„ „ „ „	Anterior ocelli and postantennal organ.
c.		Claw and tip of tibiotarsus.
d.		Mucro.
e.	„ *minuta* (Tullbg.)	Anterior ocelli and postantennal organ.
f.		Claw and empodial appendage.
g.		Mucro and dens.
h.	„ *(Isotomina) pilosa*, n. sp.	Ocelli and postantennal organ.
i.	„ „ „ „	Claw and tip of tibiotarsus.
j.	„ „ „ „	Furca.
k.	*Proisotoma sexophthalma*, n. sp.	Entire animal.
l.	„ „ „	Ocelli and postantennal organ.
m.	„ „ „	Claw and tip of tibiotarsus.
n.	„ „ „	Dens and mucro.

Var. **lutea,** n. var.

Specimens collected on the beach at Hallett's Cove, South Australia, in November, 1931 (D. C. S.), only differ from the typical form in the colouration, which is of a yellowish-green with a dark medial longitudinal streak.

PROISOTOMA MINUTA (Tullberg, 1871). (Text fig. 6, *e.-g.*)

= *Isotoma minuta* Tullberg, 1871; *Isotoma troglodytica* Rainbow, 1907.

Mucrones with 3 teeth. Tibiotarsus without clavate hairs or only with two weak ones (var. *clavipila* Axels.). Ocelli, 8 on each side. Antennae only slightly longer than the head. Colour, greyish.

This is a common species in Europe, occurring in and on soil in cultivated areas. It has been recorded from Australia by Dr. J. Davidson as occurring in large numbers in the soil of a tomato-house at Glenelg, South Australia, on June 27, 1929, and the writer found it commonly at Perth and Guildford in Western Australia, in 1931.

Through the courtesy of the authorities of the Australian Museum, Sydney, I have been able to re-examine the type slides of Rainbow's *Isotoma troglodytica*, described from Yarrangobilly Caves, New South Wales, in 1907. His specimens are identical with *P. minuta*, and therefore his name must be regarded as synonymous.

Proisotoma sexophthalma, n. sp. (Text fig. 6, *k.-n.*)

Description.—Length, to 0·7 mm. Colour, greyish with light specks. Antennae slightly shorter than the head, ratio of segments = 2 : 3 : 3 : 5. Ocelli small, 6 on each side and not on pigmented patches. P.a.o. elliptical, about 5 times the diameter of an ocellus, entire. Claws unarmed. Empodial appendage with narrow inner and broader outer lamellae. No clavate tibiotarsal hairs. Furca short and stout, not reaching beyond abdomen II.; dentes and mucrones as in fig. 9 *d*. Clothing sparse, of fairly short, simple setae, scarcely longer on apical segments.

Locality.—National Park, Western Australia, September 3, 1931 (D. C. S.).

Syntypes in the South Australian Museum.

Remarks.—This very distinct species is nearest to *P. micrura* Börner from South America, which differs in having a single distinctly clavate tibiotarsal hair, longer antennae and longer mucrones.

Key to the Australian Species of Proisotoma.

1. Abdominal segments V. and VI. fused. Subgenus, *Isotomina* Börner. 2
   Abdominal segments all distinctly separated. Subgenus, *Proisotoma*, Börner. 4
2. Ocelli, 8 on each side on a single dark patch. Anteapical tooth of mucro about the middle. *P. (I.) thermophila* (Axels).
   Ocelli, 6 on each side. 3
3. Ocelli in two groups on different patches of pigment only lightly joined. Mucro one-third the length of dens. Dentes haired the whole length dorsally. P.a.o. as long as three ocelli. *P. (I.) sexoculata*, n. sp.
   Ocelli in two groups, but on a single patch of pigment. Mucro half the length of dens. Dentes dorsally with a few short setae at tip. P.a.o. the length of a single ocellus. *P. (I.) pilosa*, n. sp.
4. Ocelli, 8 on each side on black patches of pigment. 5
   Ocelli, 6 on each side, small, and not surrounded with pigment. P.a.o. equal to 5 ocelli, elliptical. Small plump species. *P. sexophthalma*, n. sp.
5. Mucro, plump, with 2 teeth and a very broad, distinct lamella. No clavate tibiotarsal hairs. Furca reaching ventral tube. P.a.o. equal to a single ocellus. *P. schotti* (D.T.).
   Mucro without distinct lamella. 6
6. Mucro with three teeth. No clavate tibiotarsal hairs or only two very weak ones (var. *clavipila* Axels.). *P. minuta* (Tullberg).
   Mucro with two teeth. Claws unarmed. P.a.o. elliptical, entire, equal to 2-3 ocelli. Clavate tibiotarsal hairs absent. *P. ripicola* Linnaniemi.

Genus Isotoma s. str. Börner, 1906.

Isotoma tridentifera Schött, 1917.

Description.—Length, to 1·5 mm. Colour, light bluish-grey. Antennae twice as long as head. Ocelli, 8 on each side, the proximal ocelli smaller. Hairs of body short, depressed, slightly longer on end of abdomen, all simple. Claws with 2 inner teeth (absent in var. *edenticulata*, n. var.). Mucro small with two teeth.

This was the first and only true species of *Isotoma* to be previously recorded from Australia. It was originally found in North Queensland. I have had specimens collected by Miss J. W. Raff, from Beechworth, Victoria, in 1932; from New Town, Tasmania, collected by Mr. V. V. Hickman, in September, 1932; and have taken it myself around Adelaide, South Australia, in 1933.

Var. **edenticulata,** n. var. (Text fig. 4, *h.*)

The type specimen of this variety was found among debris on the shore of Government House Lake, Rottnest Island, Western Australia, in 1930 (L. J. G.). Other localities are Salt Lakes, Rottnest Island, Western Australia, January, 1931 (H. W.); Crawley, Western Australia, June, 1931 (D. C. S.); You Yang Mountains, Victoria, September, 1931 (J. W. R.); Pickering Brook, Western Australia, July, 1932 (G. E. N.); Albany, Western Australia, July, 1932 (H. W.).

Type in the South Australian Museum.

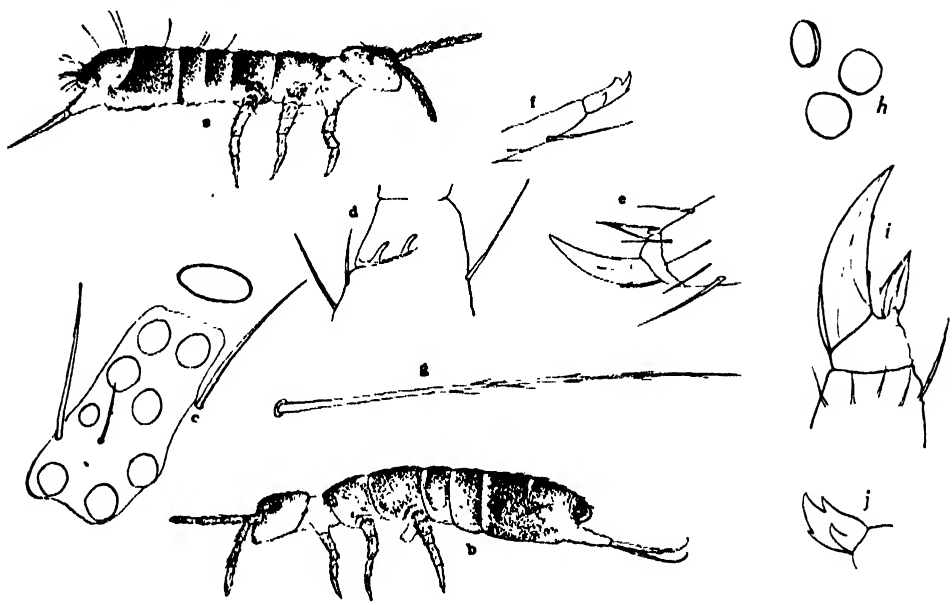


Fig. 7.

a.	*Isotoma swani*, n. sp.	Entire male animal.
b.	" " "	Entire female animal.
c.		Ocelli and p. a. o.
d.		Sensory organ on ant. III.
e.		Claw and tip of tibiotarsus.
f.		Mucro and tip of dens.
g.		Long dorsal seta of male.
h.	*georgiana* Schffr.	P. a. o. and anterior ocelli.
i.	"	Tip of tibiotarsus.
j.	"	Mucro.

Isotoma swani, n. sp. (Text fig. 7, *a-g.*)

Description.—Length, 1·4 mm. Colour, bluish-grey with whitish anterior margins to segments; whitish on venter, legs, furca and lower part of sides of head, prothorax and furcal segment. Antennae nearly one and three-quarter times the head length; ratio of segments = 15 : 20 : 20 : 32. Antennal organ III. as in figure 10 *d*. Ocelli, 8 on each side on dark patches, unequal. P.a.o. one and a half times the diameter of an anterior ocellus, broadly elliptical. Claws strong,

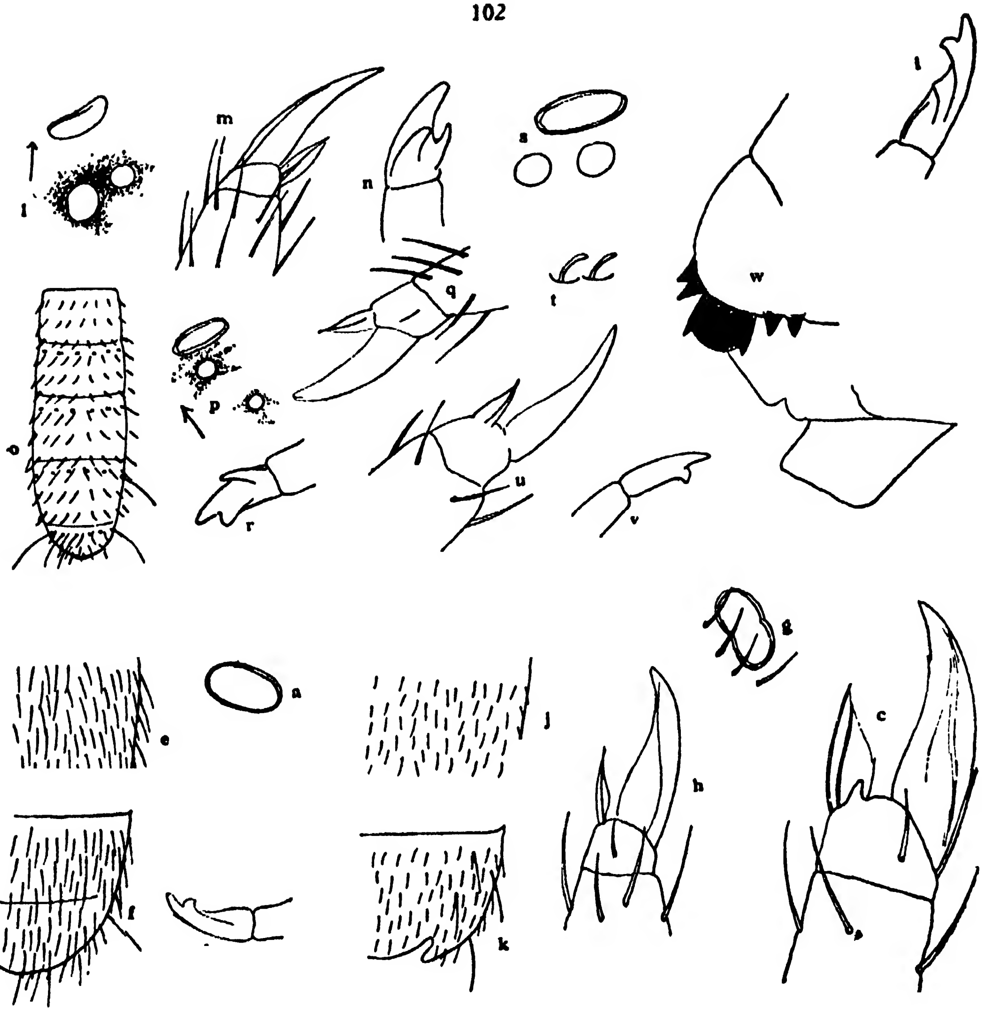


Fig. 8.

a.	*Isotoma termitophila*, n. sp.	Postantennal organ.
b.	„ „ „	Sensory organ of ant. III.
c.		Claw and empodial appendage.
d.		Mucro.
e.		Dorsal surface of abdom. IV.
f.		„ „ V. and VI.
g.	*linnaniemia*, n. sp.	Postantennal organ.
h.		Claw and empodial appendage.
i.		Mucro.
j.		Dorsal surface of abdom. IV.
k.		„ „ V. and VI.
l.	*Isotoma bioculata*, n. sp.	Ocelli and postantennal organ.
m.		Claw and tip of tibiotarsus.
n.		Mucro.
o.	„ „	Dorsal view of abdom. segments.
p.	„ *raffi*	Ocelli and postantennal organ.
q.	„ „	Claw and tip of tibiotarsus.
r.	„ „ „	Mucro.
s.	*Spinisotoma dimorpha*, n. sp.	Anterior ocelli and postantennal organ.
t.	„ „ „	Sensory organ of ant. III.
u.	„ „ „	Claw and tip of tibiotarsus.
v.	„ „ „	Mucro.
w.	„ „ „	Chitinous teeth on abdom. V. of male.

with strong inner tooth at about one-third from base, and a strong outer lateral tooth. Empodial appendage with broad inner lamella, apically pointed. Clavate tibiotarsal hairs absent. Furca long, reaching ventral tube. Mucrodens twice as long as manubrium. Mucro with 4 teeth, apical very small and not reaching subapical. Clothing of moderately numerous short and fine setae. In the male on abdominal segment are some much longer and stronger curved setae which are longer than the width of segments and coarsely ciliated; these are absent in the female.

Locality.—Holotype and allotype from National Park, Western Australia, September, 1931 (D. C. S.).

Types in the South Australian Museum.

Isotoma termitophila, n. sp. (Text fig. 8, *a-f.*)

Description.—Length, to 2·5 mm. Colour, entirely white. Antennae half as long again as the head; ratio of segments = 10 : 22 : 20 : 48; antennae IV. with a terminal knob, antennal organ III. as in figure 11, *b.*, IV. without olfactory hairs. Ocelli entirely absent. P.a.o. fairly large, broadly elliptical, not medially notched. Claws strong with fine inner tooth at one-third from tip, and a prominent outer basal tooth. Empodial appendage with outer and broad inner lamellae, the inner lamella with a fine tooth at the angle. Furca almost reaching ventral tube, dentes nearly twice as long as manubrium; mucro small with three teeth, dentes with subapical bristle reaching tip of mucro and ventrally with long setae. Rami with 4 barbs. Clothing of moderately short setae but the abdominal segments have some longer equally fine but outstanding setae; all setae simple and not ciliated.

Localities.—Type from Parkerville, Western Australia, with termites, October, 1930 (H. W.); Armadale, Western Australia, July, 1931 (H. W. and D. C. S.); King's Park, Western Australia, August, 1931 (H. W.); Crawley, Western Australia, April, 1931 (D. C. S.).

Remarks.—In morphological details this species is very close to *Isotoma sphagneticola* Axelson, but differs in having an inner and outer tooth to the claw. It should not, however, be confused owing to its very different facies. It is of the somewhat heavier build of *Folsomia*, whereas *I. sphagneticola* is more graceful, recalling the form of the *I. notabilis* group.

Isotoma linnaniemia, n. sp. (Text fig. 8, *g.-k.*)

Description.—Length, 1·0 mm. Colour, entirely white. Facies as in *Isotoma sphagneticola* Linnan. Antennae only slightly longer than the head, ratio of segments = 6 : 12 : 12 : 16. Antennae IV. with small terminal knob but no olfactory hairs. Antennal organ III. normal. Ocelli absent. P.a.o. large, elliptical, doubly contoured and with distinct indication of division. Claws unarmed. Empodial appendage pointed, about half the length of claw with narrow outer and broad inner lamellae, inner lamella with tooth. Furca short, reaching only to posterior margin of abdomen II. Mucrodens twice as long an manubrium. Mucro with three teeth almost in a line. Clothing of numerous short, simple setae, with only a few slightly longer ones on abdomen V. and VI. Ratio of th. II. : III. : abd. I. : II. : III. : IV. : V. and VI. = 32 : 25 : 22 : 25 : 30 : 20; V. and VI. completely fused.

Localities.—Crawley, Western Australia, April, 1932 (D. C. S.); Preston Valley, Western Australia, June, 1931 (H. W.); Gooseberry Hill, Western Australia, June, 1932 (G. E. N.).

Type in the South Australian Museum.

Remarks.—This species, which resembles the European *I. sphagneticola* Linnan., is separated therefrom by the fewer longer setae on abdomen V. and VI.,

and on the trochanters. These setae are also quite simple and not ciliated. The p.a.o. of *I. sphagneticola* is quite entire without any medial notch, while the furca reaches the ventral tube. From *I. termitophila*, n. sp., it differs in the general facies, the form of the p.a.o., the dentition of the claw, the structure of the empodial appendage, and in the nature of the clothing.

Isotoma bi-oculata, n. sp. (Text fig. 8, *l.-o.*)

Description.—Length, 1·0 mm. Colour, white except for the eye patch which is bluish. Antennae half as long again as the head, ratio of segments = 6 : 12 : 13 : 20; antennal organ III. normal. Ocelli, two on each side, unequal, the anterior ocellus the smaller, both close together on a small blue patch of pigment. P.a.o. kidney-shaped, twice as long as the anterior ocellus. Claws long and strong with inner tooth. Empodial appendage less than half as long as claw, with inner and outer lamellae. Furca long, reaching ventral tube. Mucrodens about three times as long as manubrium; mucro with three teeth, two in line and one distinctly lateral. Ratio of th. II. : III. : abd. I. : II. : III. : IV. : V. and VI. = 35 : 25 : 14 : 16 : 20 : 21 : 15; V. and VI indistinctly separated. Clothing generally of fairly long, simple setae, but all segments have an anterior row of six or more very long curved setae which are longer than the width of the segments and ciliated on one side.

Localities.—Sherbrook, Victoria, September, 1931 (H. F. D.); Sassafras, Victoria, December, 1931 (H. G. A.).

Remarks.—This species differs abundantly from any described forms in the two ocelli on each side and in the characteristic long ciliated setae on the body segments.

Isotoma raffi, n. sp. (Text fig. 8, *p.-r.*)

Description.—Length, 0·7 mm. Colour, greyish-white except the two small dark pigmented eye-patches on each side. Antennae half as long again as the head, ratio of segments = 8 : 11 : 11 : 20, antennal organ III. normal. Ocelli, two on each side, each on a separate patch of pigment. The anterior ocellus is the larger. P.a.o. broadly oval, twice as long as the anterior ocellus and almost touching it. Claws unarmed. Empodial appendage half as long as claw and with inner and outer lamellae. Furca reaching ventral tube, mucrodens at least two and a half times as long as the manubrium, mucro as in preceding species except that the subapical tooth is distinctly distal. Clothing of numerous fine setae with a few longer and more outstanding ones on anal segments; these are not so long as in preceding species nor are they ciliated.

Syntypes from You Yang Mountains, Victoria, September 24 (Miss J. R.); in the South Australian Museum.

Remarks.—This species is very closely related to the preceding, but may be distinguished by the characters given in the key.

Isotoma notabilis Schäffer, 1896.

Description.—Length, 1·0 mm. Light greyish in colour. Body setae short, the longer ones slightly ciliated. Antennae half as long as the head. Ocelli, 4 on each side on a dark patch. P.a.o. broadly elliptical and as long as one ocellus. Claws unarmed. Empodial appendage pointed, without teeth, half the length of claw. Dens approximately three times as long as the manubrium. Mucro with 3-4 teeth, the proximal close together.

This well-known species has been found in a green-house at Adelaide, South Australia, in March, 1933 (H. M. H.).

Isotoma bipunctata Axelson, 1903.

Description.—Length, to 0·8 mm. Colour, white. Body setae short and simple. Antennae slightly longer than the head. Antennae IV. with a small olfactory hair and terminal papilla. Ocelli, 1 on each side on a small pigmented patch. P.a.o. elliptical, as broad as 4 ocelli. Claws unarmed. Furca reaching middle of abdomen II. Manubrium as long as mucrodens. Mucro with 2-3 teeth.

This European species was taken along with the preceding, in a greenhouse at Adelaide, South Australia, in March, 1933 (H. M. H.).

Isotoma olivacea Tullberg, 1871.

Description.—Length, to 2·0 mm. Colour, olive-green with a lighter ground colour, sometimes bluish. Head and body with light flecks, extremities lighter. Clothing of short thick setae. Antennae half as long again as the head. Antennae IV. without olfactory hairs, with terminal knob. P.a.o. elliptical, as wide as one and a half to three ocelli. Claws with broad base, outer tooth and small inner tooth. Empodial appendage half the length of claw, with tooth at inner angle. Ratio of dens to manubrium = 44 : 19; dens dorsally annulated. Mucro with 4 teeth, apical the strongest and curved, proximal teeth equal.

This is another common European species. It was found in numbers in the laboratory at the Waite Institute, Adelaide, South Australia, in October, 1933, by Mr. J. W. Evans. The specimens had undoubtedly come from herbage growing outside.

Isotoma georgiana Schäffer, 1891. (Text fig. 7, *h.-j.*)

Description.—Length, to 2·0 mm. (Schäffer, 3·0 mm.). Colour, dark bluish-black, uniform. Antennae rather longer than head, ratio of segments = 7 : 9 : 9 : 13. Ocelli, 8 on each side on dark patches. Postantennal organ small, about as long as an ocellus, subelliptical (not observed by Schäffer). Furca long, reaching ventral tube, mucrodens about three times as long as manubrium, dens with numerous strong setae, mucro with four teeth, the apical one small and short, the basal teeth not opposite. Claws strong with fine proximal and distal teeth. Empodial appendage pointed with inner and outer lamellae and tooth at the inner angle. Body clothing of numerous setae, most of which are strong but short, though many are much longer.

Locality.—Two specimens of this species were taken in moss in the Coorong, South Australia, on May 17, 1934 (R. V. S.).

Remarks.—Except in the postantennal organ and the shorter antennae, particularly the fourth segment which is much shorter than the head, there are no differences in my specimens from Schäffer's description. Hitherto this species has been known only from the Subantarctic, but that it should reach the coastal regions of Southern Australia is not surprising. The writer knows of several other subantarctic species which occur in New Zealand and which will be recorded in due course.

Key to the Australian Species of Isotoma.

1. Ocelli, 8 on each side. 2
   Ocelli, fewer than 8 on each side. 4
2. Mucro with 4 teeth. 3
   Mucro with 3 teeth. Colour, light bluish-grey. Claw with 2 inner teeth or without (var. *denticulata* n. var.). *I. tridentifera* Schött.
3. Apical tooth of mucro long and slender, the proximal teeth on a level or nearly so. Not sexually dimorphic. P.a.o. equal to 1½-3 ocelli. *I. olivacea* Tullberg.

Apical tooth of mucro short, proximal teeth not level. Sexually dimorphic species, male with long ciliated setae on distal abdominal segments. P.a.o. equal to two ocelli. Claw without distal inner tooth. *I swani*, n. sp.

Apical tooth of mucro short, proximal teeth not opposite. Not sexually dimorphic. All setae strong and simple. P.a.o. equal to one ocellus. Claw with distal inner tooth. *I. georgiana* Schäffer.

4. Ocelli entirely absent. 8
Ocelli, 1, 2, or 4 on each side. 5

5. Ocelli, 1 on each side on a small patch of pigment. P.a.o. elliptical, equal to 4 ocelli. Colour, white. Mucro with 2-3 teeth. *I. bipunctata* Axelson.

Ocelli, 2 or 4 on each side. 6

6. Ocelli, 2 on each side. 7
Ocelli, 4 on each side on a dark patch. Colour, light bluish-grey. P.a.o. broadly elliptical, as long as the patch of pigment. Mucro with 3-4 teeth. *I. notabilis* Schäffer.

7. Both ocelli on same patch of pigment, anterior ocellus the smaller. P.a.o. kidney shaped, widely separated from anterior ocellus. Abdominal segments with a subposterior row of long, strongly ciliated setae. *I. bioculata*, n. sp.

Each ocellus on a separate patch of pigment, separated by at least two ocellar diameters. Anterior ocellus the larger, almost touching the p.a.o., this broadly oval, about twice as long as the anterior ocellus. No long ciliated setae on abdominal segments. *I. raffi*, n. sp.

8. Large, stout species of *Folsomia* facies. White. P.a.o. broadly elliptical, margins entire. Claws with inner and prominent basal teeth. Mucro with three teeth. Body segments with fairly long, fine setae, longer but simple on anal segments. Termitophilous. *I. termitophila*, n. sp.

Smaller species of *I. sphagneticola* facies. White. P.a.o. broadly elliptical, more elongate, lateral edges notched. Claws unarmed. Mucro tridentate. Body setae shorter and with fewer longer ones. *I. linnaniemi*, n. sp.

SPINISOTOMA Stach, 1926.

This very interesting genus was erected in 1926 for an Isotoma found in South-west Poland. It differs from related genera of the Isotominae in having a series of spines on the fifth abdominal segment. Anal spines of some form are known to occur in several genera of this subfamily, notably those placed by Börner in his tribe Anurophorini, as *Uzelia*, *Tetracanthella* and *Proctostephanus*. Stach's genus, however, is of typical *Isotoma* facies, and the terminal position of the anus definitely places it in the tribe Isotomini.

The genus is characterised thus:—Body elongate of *Isotoma* facies, all abdominal segments separated, antennae IV. without sensory knob at apex, ocelli 8 on each side, anus terminal, abdomen V. with anal horns or spines in both sexes or only in male, claw without tunica, no clavate tibiotarsal hairs, furca present and long and annulated, mucro of *Isotoma* type.

Spinisotoma dimorpha, n. sp. (Text fig. 8, *s.-w.*)

Description.—Length, 0·8 mm. Colour, ? (the two specimens have been mounted for some time and have lost any pigment originally present). Antennae one-third longer than head, ratio of segments = 8 : 10 : 10 : 19, antennae IV. without terminal knob, III. with sensory organ as in figure 12, *i*. Ocelli, 8 on each side on dark patches. P.a.o. about twice an ocellus in diameter. Claws unarmed. Empodial appendage with narrow inner and broader outer lamellae. Furca long but only reaching anterior margin of abdomen II. Mucrodens twice as long as manubrium, mucro small with two teeth. Relative lengths of body segments = th. II. : III. : abd. I. : II. : III. : IV. : V. : VI. = 25 : 30 : 18 : 20 : 20 : 20 : 10 : 5. Abdomen V. posteriorly in male with 6 strong and

stout heavily chitinised yellow spines or teeth arising directly from the cuticle; the two outer spines on each side are triangular and only slightly longer than broad at their base; the two inner ones are rather longer and joined together just below their apices to form a saddle piece. Clothing of numerous short and fine setae, none of which are much longer towards the apex.

Locality.—One male and one female in grass sweepings at Urrbrae, South Australia, in October, 1929 (D. C. S.).

Types in the South Australian Museum.

Remarks.—The structure of the spines in this species differs from those of the genotype *Spinisotoma pectinata* Stach, in that they arise direct from the cuticle or surface of the segment. In Stach's species they are only four in number and placed on distinct and prominent papillae. The crown of thorns (about 30) on the same segment in *Proctostephanus stuckeri* Börner appears to be of a similar nature to those in our species, but *Proctostephanus* is placed by Börner in the tribe Anurophorini.

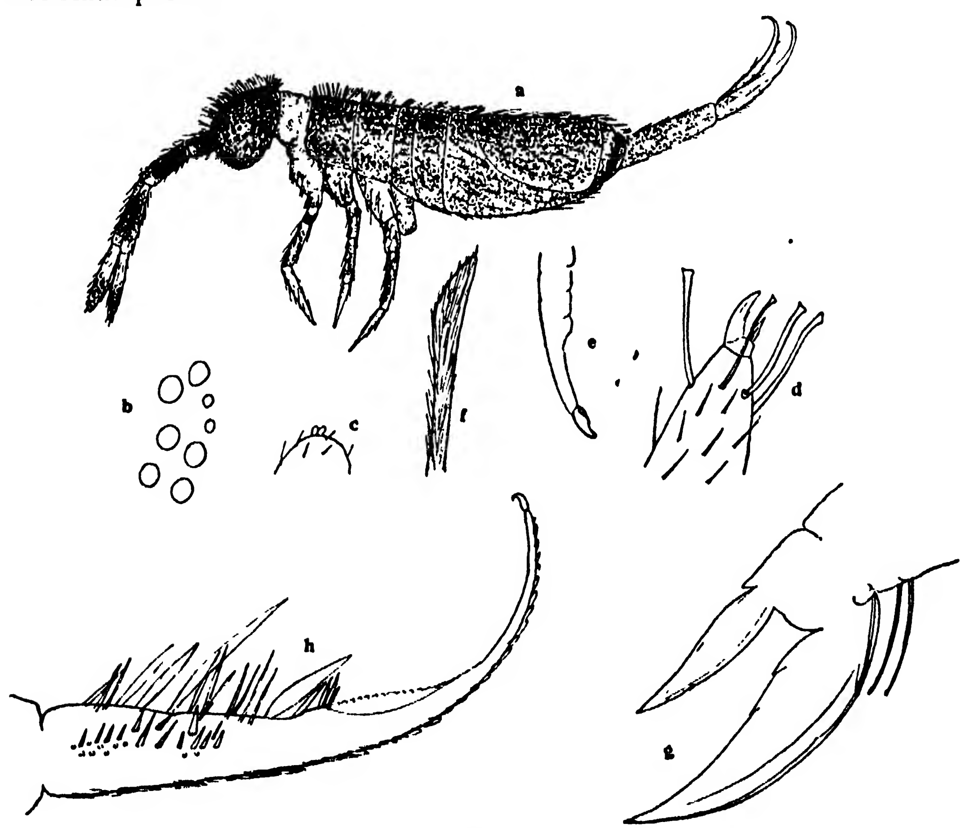


Fig. 9.

a. Isotobrya wheeleri, n. g., n. sp.	Entire animal.
b. „ „ „ „	Ocelli.
	Tip of ant. IV.
	Tip of tibiotarsus.
	Mucro and tip of dens.
f. „ „ „ „	Ciliated thoracic hair.
g. Lepidophorella australis Carp.	Claw, empodial appendage, and tip of tibiotarsus.
h. „ „ „	Dens and mucro.

Genus **Isotobrya**, gen. nov.

Description.—General facies of *Entomobrya* type. Abdomen IV. several times longer than III. Antennae long, 4-segmented, IV. with double terminal knob. Clavate tibiotarsal hairs present. Claws simple, of *Isotoma* type. Furca long, dentes faintly annulated, mucro falciform. Clothing of numerous long ciliated setae which are clavate on the head and thorax. Abdominal segments apparently without sensory setae. Empodial appendage present. Scales absent.

Remarks.—This genus is extremely interesting in that it connects in many characters the subfamilies Isotominae and Entomobryinae. In its general form and clavate ciliated thoracic setae it agrees with the latter; in its simple claws with the former.

Genotype.—*Isotobrya wheeleri*, n. sp.

Isotobrya wheeleri, n. sp. (Text fig. 9, *a.-f.*)

Description.—Length, 2·0 mm. Colour, blackish, except on legs, furca, prothorax and base of antennae IV., which are white. Antennae nearly three times as long as head, ratio of segments = 6 : 10 : 7 : 10. Ocelli, 8 on each side, unequal, not on a dark patch. P.a.o. absent. Legs long, tibiotarsus with 4 clavate tibiotarsal hairs; claws with faint inner tooth about the middle. Empodial appendage simple, lanceolate and half as long as claw. Furca reaching ventral tube, ratio of manubrium to mucrodens = 20 : 20, mucro falciform with small basal lamellae, but without basal spine. Clothing of numerous long ciliated setae, many on the head and thorax clavate. Abdominal sensory setae absent. Termitophilous.

Four specimens of this interesting species were found under a stone with termites at Mullewa, Western Australia, on September 9, 1931. As the writer was with that delightful companion and entomologist, Professor W. M. Wheeler, of Harvard, when the specimens were taken, it is with very pleasant memories that his name is associated with the species.

Syntypes in the South Australian Museum.

Family TOMOCERIDAE (Schäffer, 1896).

Subfamily LEPIDOPHORELLINAE (Börner, 1897).

Genus LEPIDOPHORELLA Schäffer, 1897.

Syn. = *Drepanura* Moniez, 1894; nec. Schött, 1891.

LEPIDOPHORELLA AUSTRALIS Carpenter, 1925. (Text fig. 9, *g.-h.*)

Description.—Length, 3-4 mm. Colour, pale straw-yellow with basal rings on the second antennal segment, and the whole of the fourth segment dark purple; also with dark patches dorsally on thorax II. and abdomen I., II., IV. and V. Antennae three-fourths as long again as head, ratio of segments = 8 : 18 : 18 : 24. Ocelli, 8 on each side on dark fields. P.a.o. absent. Thorax II. two and a quarter times as long as III. Abdomen III. a third as long again as IV. Claws with strong dorsolateral and two prominent inner teeth. Empodial appendage lanceolate. Dentes one-third as long again as the manubrium, mucro falciform with upturned apex. Tibiotarsi with clavate hairs. Body covered with ribbed scales.

Locality.—Sherbrook, Victoria, April, 1931 (H. F. D. & H. G. A.).

Remarks.—This species, not previously recorded from Australia, was originally described from Campbell Island, New Zealand, by Dr. Carpenter in 1925. The above brief characters are taken from his description, but the figures are from Australian specimens. From the following species, *L. brachycephala*

(Moniez), which also occurs in both countries, it differs in having only two inner teeth to the claw and in the presence of the clavate tibiotarsal hairs.

LEPIDOPHORELLA BRACHYCEPHALA (Moniez).

= *Drepanura brachycephala* Moniez.

Localities.—Launceston, Tasmania, August, 1929 (V. V. H.); Cascades, Tasmania, August, 1932 (V. V. H.); Mount Nelson, Tasmania, September, 1932 (V. V. H.).

Family ENTOMOBRYIDEA Börner, 1913.

Subfamily ENTOMOBRYINAE Börner, 1906.

Tribe ENTOMOBRYINI Börner, 1906.

Genus SINELLA Brook, 1882.

SINELLA COECA (Schött), 1896; (Text fig. 10, *a.-b.*)

= *Entomobrya coeca* Schött, 1896; *Sinella hofti* Schäffer, 1896; *Sinella tenebricosa* Folsom, 1902.

Description. Length, to 2·0 mm. Entirely white and without ocelli. Hairs thick and close-lying, ciliated. Clavate tibiotarsal hairs absent. Claw with two large wing-like teeth basally on inside, and a strong inner tooth. Empodial appendage with outer wing-like tooth. Mucro falciform with strong basal spine.

This is a well-known European species which is found under stones in the open and under boards and plant-pots in green-houses. I have seen specimens from the following Australian localities:—Perth, Western Australia, in September and October, 1930 (H. W.); Bridgetown, Western Australia, December, 1930 (H. W.); Denmark, Western Australia, September, 1932 (H. W.); Brisbane, Queensland, October, 1932 (R. J. M. B.); Adelaide, South Australia, 1933 (H. W.).

SINELLA TERMITUM Schött, 1917. (Text fig. 10, *c.*)

= *Entomobrya cuniculicola* Pritchard, 1932.

Description.—Length, 1·0 mm. Colour, white with some small red pigment spots occasionally on head and thorax. Occasionally pigmented eye-spots are present. Antennae twice as long as head, IV. without terminal knob but with thick outstanding bristles. Thorax II. distinctly longer than III. Abdomen IV. three to four times as long as III. Claw with small lateral tooth and two unequal inner wing-teeth. Empodial appendage with large outer wing-tooth. Mucro with two teeth and basal spine. Body hairs strongly ciliated, clavate on head and thorax.

This common species was, except for the mucro, well figured by Schött. It is easily separated from the only other blind species by the bidentate mucro. It was recorded by Schött from North and South Queensland, but is widely distributed in all the southern portion of Australia, occurring with various species of ants and termites.

Localities.—Armadale, Western Australia, July, 1930 (D. C. S.); Beverley, Western Australia, October, 1930 (H. W.); Mundaring, Western Australia, February, 1930 (H. W.); Mount Lofty Ranges, South Australia, March, 1931 (D. C. S.); Sherbrook, Victoria, April, 1931 (H. G. A. and H. F. D.); Mandurah, Western Australia, April, 1931 (H. W.); Glen Osmond, South Australia, 1933 (H. W.); Reedbeds, South Australia, April, 1933 (H. W.); Victor Harbour, South Australia, January, 1934 (H. W.); Adelaide, South Australia, March, 1934, along with *Coptotermes*, sp. (H. W.).

Genus Entomobrya Rondani, 1861.

Syn. = *Podura* Linne, 1740 (ad partem); *Chorutes* Burmeister, 1838 (ad partem); *Isotoma* Bourlet, 1839 (ad partem); *Degeeria* Nicolet, 1841 (ad partem).

In this genus few characters of morphological importance are available for specific purposes, and one is therefore almost wholly forced to rely on colour and markings.

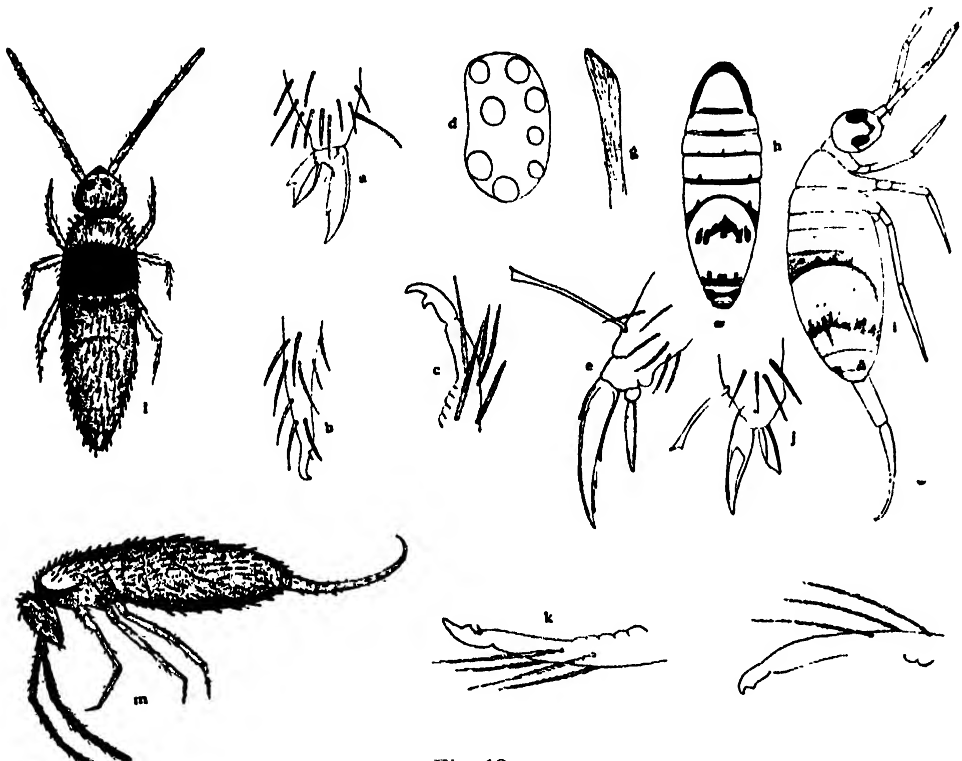


Fig. 10.

a.	*Sinella cocca* Schött.	Claw, empodial appendage and tip of tibio-tarsus.
b.	„ „ „	Mucro and tip of dens.
c.	„ *termitum* „	Mucro and tip of dens.
d.	*Entomobrya clitellaria* Guth.	Ocelli.
e.	„ „ „	Claw, empodial appendage and tip of tibio-tarsus.
f.	„ „ „	Mucro and tip of dens.
g.	„ „ „	Ciliated thoracic hair.
h.	„ *multifasciata* Tllbg.	Dorsal markings.
i.	*Entomobrya maritima,* n. sp.	Entire animal.
j.	„ „ „	Claw, empodial appendage and tip of tibio-tarsus.
k.	„ „ „	Mucro and tip of dens.
l.	*Entomobrya clitellaria* Guth.	Typical form, dorsal view.
m.	„ „ *v. newmani,* n. v.	Lateral view.

Entomobrya clittelaria Guthrie, 1902. (Text fig. 10, *d.-g.; l.-m.*)

This species was originally described by Guthrie from Minnesota, U.S.A., and has not hitherto been found outside of America. In Western and South Australia it is widely distributed. The typical form described by Guthrie has the

black band extending to the posterior margin of the third thoracic segment, whereas in the common form in Australia this band ends sharply at the anterior margin of the second abdominal segment. The ground colour is golden yellow, except on the mesothorax where it is white medially. There is a black neck-band and the tips of antennae II., III. and IV. are black. This, the common Australian form, does not differ sufficiently from the American to warrant a varietal name, but there occurs another form in which the black band on the body is entirely wanting. To this form I give the name of *E. clittelaria* var. **newmani,** after Mr. L. J. Newman, Government Entomologist of Western Australia. In addition to both forms being widely occurring in Western and South Australia, I have also received specimens from Studley Park, Victoria, August, 1931 (H. G. A.).

ENTOMOBRYA MULTIFASCIATA (Tullberg, 1871). (Text fig. 10, *h.*)

= *Degeeria multifasciata* Tullberg, 1871; *Entomobrya decemfasciata* (Packard, 1873), Handschin, 1929.

In this species there is a narrow black band on the front of the mesonotum, another on the posterior edge, and also on the posterior edge of the metathorax and all abdominal segments. There is also an irregular band in the middle of abdomen IV. In these markings there is considerable variation and on the strength of the bands not being broken in the middle in some specimens, Handschin (134) resurrected Packard's species *decemfasciata.* In correspondence, Dr. Folsom and Prof. Mills, in America, have criticised this action on the ground that it is impossible now to know what species Packard had before him. The differences in the markings are so small that I am inclined to agree, and herewith place all my material under Tullberg's name, although all specimens seen from Australia (as well as those which I have recently recorded from South Africa) agree with Handschin's data for Packard's form.

This species is almost cosmopolitan in its distribution, and in Australia is to be found in most cultivated places in the southern and western States.

ENTOMOBRYA MARGINATA (Tullberg, 1871).

= *Degeeria marginata* Tullberg, 1871; ? *Entomobrya multifasciata* Brook, 1883; *Entomobrya coerulea* Becker, 1902.

This species was recorded in its typical form from North Queensland by Schött in 1917. It is of a uniform lighter or darker violet colour with the posterior edges of the segments having a fine darker edging. In his paper Schött also described a new variety, *laticlavia,* in which the junctions of the tergites are without pigment and the free edges of thorax II. and III. have a broad dark border.

The typical form is plentiful in cultivated places in both Western and South Australia.

The pale variety, *pallida* Krausbauer, 1902, has not previously been recorded from Australia, although it is known from the Bismarck Archipelago. I have taken it at Muresk, October, 1930, and Mullewa, September, 1931, both in Western Australia.

ENTOMOBRYA TERMITOPHILA Schött, 1917.

A single specimen of this striking form was taken from moss from Mount Gambier, South Australia, in May, 1934 (R. V. S.).

ENTOMOTRYA VIRGATA Schött var. **nigrella** var. nov.

This variety differs from the typical form only in that the pigment is continuous between the bands on metanotum and third abdominal segment. A single

specimen was collected from moss from Waterfall Gully, South Australia, in May, 1934 (R. V. S.).

Type in the South Australian Museum.

ENTOMOBRYA TENUICAUDA Schött, 1917.

This species was described by Schött from the Mjöberg material collected in South Queensland. It was very well figured in his paper. I have taken specimens at Muresk, Western Australia, in October, 1939, and have also received specimens found in garden rubbish at New Town, Tasmania, in September, 1932, collected by Mr. V. V. Hickman.

ENTOMOBRYA LAMINGTONENSIS Schött, 1917.

This is an entirely blue species, except for the depigmented flecks and streaks on the anterior part of abdomen IV. It was originally described from the Mjöberg material collected in South Queensland. It is very closely related to *E. ambigua* Schött from North Queensland, which differs only in that the ante-apical tooth of the mucro is reduced. My records for this species are as follows:—Perth, Western Australia, November 18, 1930 (H. W.); Nangara, Western Australia, November 21, 1930 (B. A. O'C.); Mundaring, Western Australia, February, 1931 (H. W.); Crawley, Western Australia, 1931 (H. W.); You Yang Mountains, Victoria, September 24, 1931 (J. R.); Adelaide, South Australia, May, 1933 (H. W.); in moss, Waterfall Gully, South Australia, May 6, 1933 (H. W.).

ENTOMOBRYA VARIA Schött, 1917.

Specimens referable to this well described and figured species were collected in large numbers by sweeping the low herbage in King's Park, Perth, Western Australia, on September 5, 1931. It also occurred in large numbers under the loose bark of Karri trees at Denmark, Western Australia, and was found commonly in a similar habitat but on Eucalypts at Morialta, South Australia.

Entomobrya maritima, n. sp. (Text fig. 10, *i.-k.*)

Description.—Length, to 2·0 mm. Colour, yellowish with a dark spot between the antennae connected by a black line to the black ocellar patches. Third abdominal segment with posterior edge black, then a lighter line followed by a dark irregular band; abdomen IV. with an irregular dark cross band placed rather beyond the middle. Posteriorly on abdomen IV. is a pair of lateral black spots. Antennae three times as long as head, ratio of segments $= 2\frac{1}{2} : 6 : 6 : 7$. Ocelli, 8 on each side, equal. Mesothorax nearly twice as long as metathorax. Claws as in the genus but entirely without inner or lateral teeth. Empodial appendage apically with inner lamella. Tibiotarsus with strong, apically spathulate spur hair. Mucro bidentate with basal spine, unannulated portion of dens three times as long as mucro. Abdomen IV. in medial line about five times as long as III. Clothing of the usual ciliated hairs, clavate on thorax and head.

Locality.—Beneath and on the surface of stones between tide marks at Christie's Beach, South Australia, January 17, 1932 (D. C. S.).

Syntypes in the South Australian Museum.

ENTOMOBRYA NIVALIS Linne, 1758, f. IMMACULATA Schäffer, 1896.

= *Entomobrya nivalis-pallida* Carl, 1901; *Degeeria lanuginosa* Nicolet, 1841; *Entomobrya multifasciata-lanuginosa* Brook, 1884; *E. flava* Lie-Pettersen, 1896.

This is a well-known European species of which the form *immaculata* Schäffer occurs commonly around Adelaide, South Australia, on cultivated land.

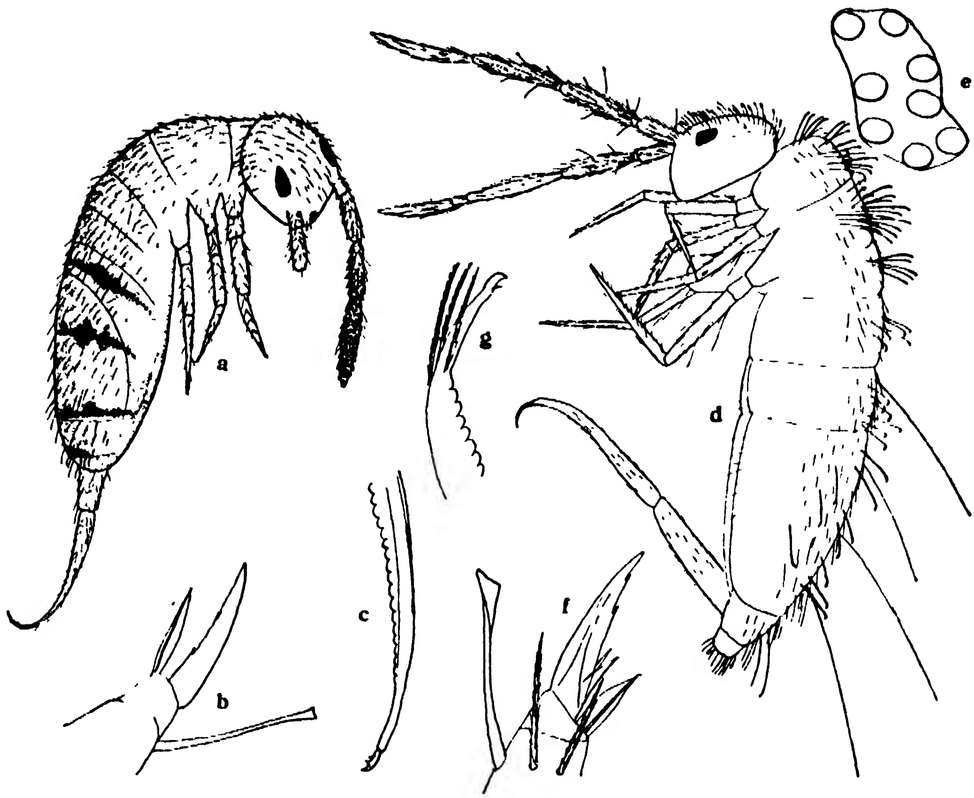


Fig. 11.

a. *Entomobrya mitchelli*, n. sp. Entire animal.
b. „ „ „ Claw, empodial appendage, and tip of tibiotarsus.
c. „ „ „ Mucro and tip of dens.
d. *Drepanura citricola*, n. sp. Entire animal.
e. „ „ „ Ocelli.
f „ „ „ Claw, empodial appendage, and tip of tibiotarsus.
g. „ „ „ Mucro and tip of dens.

Entomobrya mitchelli, n. sp. (Text fig. 11, *a.-c.*)

Description.—Length, 1·2 mm. Colour, light yellowish-green with a blue cross-patch on abdomen III. and two on IV.; ocellar patches blue-black. Ocelli, 8 on each side. Antennae twice, or nearly so, as long as the head; ratio of segments = 3 : 6 : 6 : 9. Mesothorax one and three-fifth times as long as metathorax. Claws narrow, with two indistinct inner teeth and a lateral tooth. Empodial appendage lanceolate, reaching well beyond the distal inner tooth of claw. Furca long and thin, annulated. Mucro bidentate with basal spine. Unannulated portion of dens 3-4 times as long as mucro. Clothing normal.

This species was originally obtained by sweeping the low herbage in King's Park, Perth, Western Australia, in September, 1931 (H. W.), and later at Mount Barker, Western Australia, in September, 1932 (H. W.). It is named after Sir James Mitchell, then Premier of Western Australia.

Syntypes in the South Australian Museum.

Entomobrya tasmanica, n. sp. (Text fig. 12, *a.-c.*)

Description.—Length, 1·4 mm. Colour, light but with heavy broad blue bands on all segments and occupying the whole of the meso- and metathoracic segments and quite the posterior halves of the other segments. Antennae rather less pigmented, blue on the whole of III. and IV. and apically on I. and II. Antennae about twice as long as head. Ocelli, 8 on each side, the proximal pair very small and inconspicuous. Claws typical of the genus without lateral tooth, with a proximal pair of large and prominent teeth at about the middle of the inner edge, then a very distinct inner tooth followed by a finer more distal tooth. Empodial appendage not reaching the proximal teeth of claw, truncate apically. Furca long and reaching abdomen I., mucro bidentate with basal spine, annulated portion of dens five times as long as mucro and with three long ciliated setae. Mesothorax slightly longer than metathorax. Abdomen IV. five times as long as III. Clothing normal.

Locality.—Two specimens collected in the Domain, Hobart, Tasmania, in October, 1932, by Mr. V. V. Hickman.

Syntypes in the South Australian Museum.

Key to the Australian Species of Entomobrya.

1. Insects of a uniform colour. 8
   Insects marked with cross-bands or irregular markings. 2
2. Markings consisting of irregular spots, more or less forming longitudinal streaks. *E. varia* Schött.
   Markings in the form of broad bands occupying most of the posterior portions of the segments. *E. tasmanica*, n. sp.
   With narrow bands or banded on certain segments only. 3
3. With only a single cross-band on thorax or abdomen. 4
   With many cross-bands. 5
4. Black band on thorax III., abdomen I. and II. (or absent = var. *newmani* n. var.). Golden yellow species with thorax II. dorsally white. *E. clitellaria* Guthrie.
   Black cross-bands on abdomen III. and anterior part of IV. Yellowish-white species. Termitophilous. *E. termitophila* Schött.
5. Species with 3 to 4 broad cross-bands. 6
   Species with more, 8 to 10 narrower bands. 7
6. White species with broad cross-bands on thorax III., abdomen III. and posterior edge of IV., or this area all pigmented; also with a thin dark line on II. on the posterior border. Posterior edges of abdomen V., and all of VI., darkish. *E. virgata* Schött.
   Yellowish species with dark irregular bands of pigment on abdomen III., and just beyond middle of abdomen IV., and laterally on V. Empodial appendage truncate apically and broad. *E. maritima*, n. sp.
7. Three bands of dark pigment, one across middle of abdomen III., one just about middle or before of IV., and another posteriorly on IV. Empodial appendage normal. *E. mitchelli*, n. sp.
7. Dorsal bands broad, on abdomen II. extending the whole length of segment. Anteapical tooth of mucro reduced. *E. tenuicauda* Schött.
   Dorsal bands much narrower, largely confined to posterior margins of segments, interrupted or not in the middle. *E. multifasciata* (Tullberg)
8. Colour entirely yellowish-green, except for the ocellar patches and a spot between the antennae. *E. nivalis* Linne; f. *immaculata* Schäffer.
   Colour otherwise. 9
9. Anteapical tooth of mucro reduced, almost a falciform mucro. Colour entirely blue. *E. ambigua* Schött.
   Anteapical tooth of mucro normal. 10

10. Deep blue with depigmented flecks and streaks on abdomen IV. Mucro with two well developed teeth and basal spine. *E. lamingtonensis* Schött.

Pigment of a light violet or cobalt blue, with darker hind edges to segments. 11

11. Darker hind edges of segments present. *E. marginata* (Tullberg); var. *pallida* Krausbauer.

12. Pigmentation violet and uniform, except for the darker posterior margins of segments. *E. marginata* (Tullberg) *f. p.*

Pigmentation of a light cobalt blue. Intermediate portions of tergites without pigment. Hind margins of segments with a broader, darker band. Apical tergite and between antennae bases black. *E. marginata* (Tullberg); var. *laticlavia* Schött.

Genus DREPANURA Schött, 1891 (nec. Moniez, 1894).

This genus, erected by Schött in 1891 (223) for *Drepanura californica*, differs from the preceding in having a falciform instead of a bidentate mucro. Since then it appears to have been ignored by other workers, and even in his own paper (226) Schött does not use it and places three species with falciform mucro in the genus *Entomobrya*. Recent workers on other groups of genera such as those previously included in the old genus *Lepidocyrtus* of Bourlet have made use of this difference in the form of the mucro to divide them up; it would therefore seem perfectly justifiable to resurrect the genus *Drepanura* with *D. californica* Schött as the genotype.

Some three years later than Schött, Moniez used the name *Drepanura* for a species *D. brachycephala* from New Zealand. It has been shown by Denis, however, that the name was misapplied and that Moniez's species belongs to the genus *Lepidophorella*.

DREPANURA COBALTINA (Schött, 1917).

= *Entomobrya cobaltina* Schött.

Description.—Length, to 1·0 mm. Colour, entirely cobalt blue. Antennae scarcely twice as long as the head. Thorax II. half as long again as III. Abdomen IV. four and a half times as long as III. Ocelli, 8 on each side on dark patches. Claw with two distal teeth. Empodial appendage pointed. Mucro falciform with basal spine.

Locality.—Muresk, Western Australia, in October, 1920 (H. W.).

Drepanura citricola, n. sp. (Text fig. 11, *d.-g.*)

Description.—Length, to 2·0 mm. Colour, light yellowish-green, except for the black ocellar patches. Ocelli, 8 on each side, equal. Antennae three times as long as the head, ratio of segments = 5 : 12 : 10 : 12. Ratio of meso- to meta-thorax = 10 : 6. Claws with a pair of large basal teeth and two distal inner teeth. Empodial appendage lanceolate with narrow outer and broader inner lamellae. Tibiotarsal spur hair long, strong and spathulate and reaching the first of the distal teeth of the claw. Furca long, dentes annulated, mucro falciform with strong basal spine. Unannulated portion of dens twice as long as the mucro. Ratio of length of abdomen III. : IV = 1 : 3-4. Clothing of numerous long ciliated hairs which are clavate on thorax and head; on abdomen III. to V. the longer hairs are pointed and as long as the length of abdomen IV.

Locality.—Perth, Western Australia, October, 1930 (H. W.), and onwards.

Remarks.—This species is very common in the Perth area and can be got in large numbers by sweeping the native bush. It also frequents cultivated flowers in gardens and is occasionally found indoors. In the South Australian Museum

are some specimens labelled as from "Townsville, North Queensland, under boards" but without any date.

Type and *paratypes* in the South Australian Museum.

DREPANURA COERULEOPICTA (Schött, 1917).

= *Entomobrya coeruleopicta* Schött, 1917.

Description.—Length, to 1·5-2·0 mm. Colour, whitish with bluish cross bands on posterior edges of segments. Antennae 2½-3 times as long as head. Thorax III. : IV. = 1 : 3. Ocelli, 8 on each side. Tibiotarsal spur hair as long as claw. Claw slender, with one medial and one distal inner tooth. Empodial appendage lanceolate. Ratio of manubrium to mucrodens = 1 : 1½. Mucro falciform with basal spine.

Localities.—Waterfall Gully, South Australia, May, 1933 (H. W.); Glen Osmond, South Australia, July, 1933 (H. W.).

Remarks.—The specimens from the above localities have the bluish pigmentation somewhat more diffuse than indicated in Schött's figure.

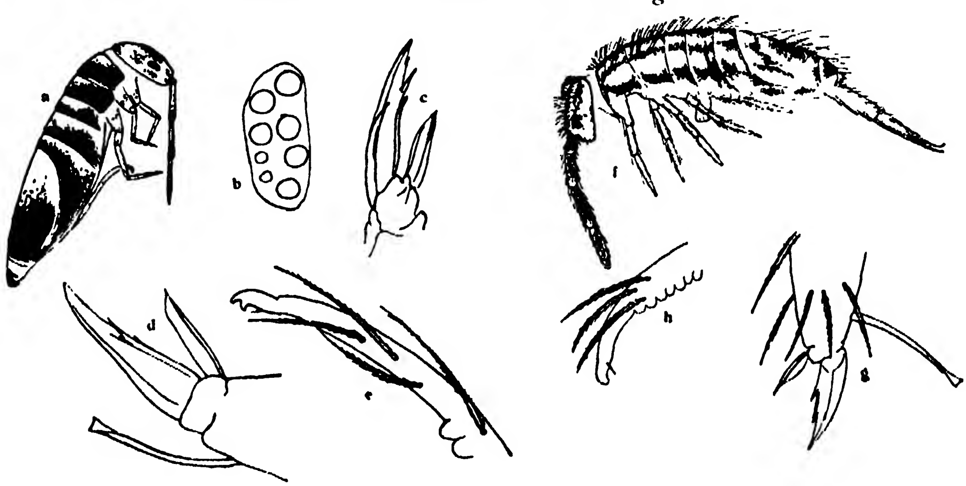


Fig. 12.

a.	*Entomobrya tasmanica*, n. sp.	Entire animal.
b.	" " "	Ocelli.
c.		Claw, empodial appendage, and tip of tibiotarsus.
d.		" " another view.
e.		Mucro and tip of dens.
f.	*Drepanura cinquilineata*, n. sp.	Entire animal.
g.		Claw, empodial appendage, and tip of tibiotarsus.
h.		Mucro and tip of dens.

Drepanura cinquilineata, n. sp. (Text fig. 12, *f.-h.*)

Description.—Length, to 1·4 mm. Colour, yellow with five longitudinal brownish-black stripes. Antennae two and a half times as long as the head, ratio of segments = 5 : 12 : 10 : 13. Mesothorax half as long again as the metathorax. Furca reaching posterior edge of abdomen II. Ratio of manubrium to mucrodens = 17 : 24. Mucro falciform with basal spine, one-third the length of hind claw. Ocelli, 8 on each side on dark patches. Claws with basal tooth and one, more distal, tooth. Empodial appendage reaching to or just beyond the distal tooth of the claw, pointed. Clothing normal.

Localities.—On garden flowers, Bridgetown, Western Australia, June, 1932 (H. G. A.); Muresk, Western Australia, 1932 (H. W.); Mount Barker, Western

Australia, September, 1932 (H. G. A.); Victor Harbour, South Australia, January, 1934 (H. W.).

Type in the South Australian Museum.

KEY TO THE AUSTRALIAN SPECIES OF DREPANURA SCHÖTT.

1.	Unicolourous species.	2
	Species with cross-bands or longitudinal streaks.	3
2.	Entirely blue species.	*D. cobaltina* (Schött).
	Yellowish-green species.	*D. citricolor*, n. sp.
3.	Banded species.	4
	With five longitudinal stripes.	*D. cinquilineata*, n. sp.
4.	Thorax I., abdomen II., III., and most of IV. black, rest white.	*D. albocoerulea* (Schött).
	Yellowish-white with narrow bluish cross-band on abdomen III. and IV.	*D. coeruleopicta* (Schött).

Genus PSEUDOSINELLA Schäffer, 1897.

Syn. = *Lepidocyrtus* Packard, 1873; *Tullbergia* Lie-pettersen, 1896; *Sira* Schäffer, 1900.

PSEUDOSINELLA DUODECEMOCULATA Handschin, 1928. (Text fig. 13, *e.*)

Description.—Length, to 2·5 mm. Colour, yellowish-white. Ocelli, 6 on each side on a dark patch. Claw with inner tooth and basal wing-like tooth. Empodial appendage lanceolate, simple.

Locality.—Two specimens were taken in moss at Crawley, Western Australia, in 1931 (H. W.).

Pseudosinella fasciata, n. sp. (Text fig. 13, *a.-d.*)

Description.—Length, 1·5 mm. Colour (in spirit, denuded of scales), dirty yellow with a band of blue pigment on abdomen III., other segments with a slight suffusion of blue dorsally. Antennae half as long again as the head, ratio of segments = 10 : 25 : 25 : 37. Ocelli, 6 on each side as in the preceding species, on a dark patch. Mesothorax half as long again as the metathorax. Claws with a pair of basal wing-like teeth on inner side and a faint distal inner tooth. Empodial appendage broad and apically truncate. Tibiotarsal spur hair pointed. Abdomen IV. four times as long as III. Clothing of simple, oval or rounded scales. Furca stout, manubrium slightly longer than the mucrodens, both dentes and manubrium heavily scaled. Mucro bidentate with basal spine. Appendages and body segments heavily beset with setae which are finely ciliated. On the thoracic segments the setae are clavate.

Localities.—In hot-house, Perth, Western Australia, February, 1931 (H. W.); Sherbrook Falls, Victoria, April, 1931 (H. G. A.); Sassafras, Victoria, December, 1932 (H. G. A.).

Type in the South Australian Museum.

PSEUDOSINELLA SEXOCULATA Schött, 1902.

= ***Pseudosinella voigtsi*** Börner, 1903. ***Lepidocyrtus sexoculata*** Guthrie, 1903; Wahlgren, 1906; Linnaniemi, 1912.

A species very close to *P. duodecemoculata* Handschin but differing in the number of ocelli, 3 on each side instead of 6.

Locality.—Beverley, Western Australia, October 7, 1930.

PSEUDOSINELLA MARTELLI (Carpenter, 1895). (Text fig. 13, *f.*)
= *Cyphoderus martelli* Carp., 1895; *Pseudosinella immaculata* Schött, 1902; *P. argentata* Folsom, 1902; *Lepidocyrtus cavernarum* Stach, 1922.

Description.—Length, 2·0 mm. Silvery white. Ocelli entirely wanting. Body heavily scaled. Claw with a large basal wing-tooth as well as a smaller one, and with two distal inner teeth. Empodial appendage half as long as claw and with rounded outer lamella. Spathulate tibiotarsal hair present but often weak. Mucro falciform with basal spine.

Locality.—In numbers under plant pots in the hot-houses of Government House, Perth, Western Australia, in 1931 (H. W.).

Remarks.—This is a well-known species in Europe and America, occurring in caves, under stones, etc.

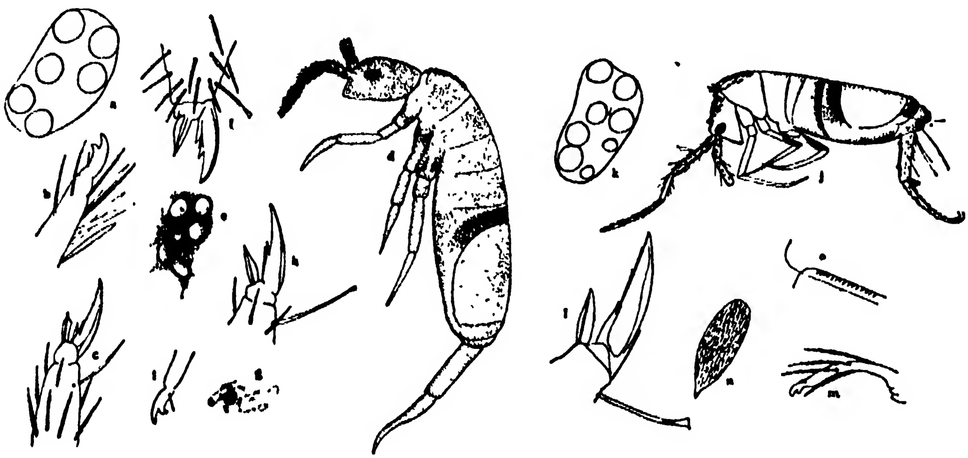


Fig. 13.

a.	*Pseudosinella fasciata*, n. sp.	Ocelli
b.	„ „ „	Mucro and tip of dens.
c.		Claw, empodial appendage, and tip of tibiotarsus.
d.		Entire animal.
e.	*duodecimoculata* Hndn.	Ocelli (after Handschin).
f.	*martelli* Carp.	Claw, empodial appendage, and tip of tibiotarsus (after Handschin).
g.	„ *unioculata*, n. sp.	Ocellus.
h.	„ „ „	Claw, empodial appendage, and tip of tibiotarsus.
i.	„	Mucro.
j.	*Mesira fasciata*, n. sp.	Entire animal.
k.		Ocelli.
l.		Claw and empodial appendage.
m.		Mucro and tip of dens.
n.		Scale.
o.		Spines on posterior edge of head.

Pseudosinella unioculata, n. sp. (Text fig. 13, *g.-i.*)

Description.—Length, to 0·8 mm. Colour, white, except for a little blue pigment around the deeply pigmented single ocellis on each side. Antennae half as long again as the head, ratio of segments = 6 : 10 : 10 : 20. Claws with two prominent basal wing-teeth. Empodial appendage with broad inner and narrower outer lamellae. Spathulate tibiotarsal hair well developed. Mucro bidentate with basal spine. Clothing of scales and the usual ciliated clavate hairs.

Localities.—Crawley, Western Australia, November, 1930 (D. C. S.); You Yang Mountains, Victoria, September, 1931 (J. W. R.); St. Ronan's Well, Western Australia, June, 1932 (G. E. N.).

Type in the South Australian Museum.

Remarks.—This species is parallel with *Sinella monoculata* Denis, the difference lying in the generic characters.

KEY TO THE AUSTRALIAN SPECIES OF PSEUDOSINELLA.

1.	Ocelli, 6 on each side.	2
	Ocelli fewer than 6 on each side.	3
2.	Species with dark band on abdomen III. Empodial appendage apically truncate.	*P. fasciata*, n. sp.
	Species without abdominal band. Empodial appendage apically pointed.	*P. duodecemoculata* Hndn.
3.	Ocelli absent. Mucro falciform.	*P. martelli* (Carp.).
	Ocelli present.	4
4.	Ocelli, 3 on each side.	*P. sexoculata* Schött.
	Ocelli, 2 on each side.	[1] *P. alba* (Pack.) Schffr.
	Ocelli, 1 on each side.	*P. unioculata*, n. sp.

Genus SIRA Lubbock, 1869.

Two species of this genus were described from Australia by Schött (226), namely, *Sira abrupta* and *S. tricincta*. There would seem to be some little doubt as to whether these are strictly members of this genus, but the species have not been rediscovered since they were first found.

SIRA PLATANI (Nicolet), 1841), f.p.

The above well-known European species was found in fair numbers under boards in a garden at Alberton, near Adelaide, South Australia, in March, 1934 (H. W.).

Handschin (127) has shown that the various European species of *Sira*—*S. platani* (Nic.), 1841; *S. flava* Agr., 1903; *S. nigromaculata* Lubb., 1870; and *S. corticalis* Carl., 1899—are all colour forms of the same species gradually increasing in the intensity of the abdominal bands until the almost black form *platani* is reached, and that as this form has priority the species should be known by that name.

The specimens from Alberton are somewhat intermediate between a dark *corticalis* and the typical *platani*.

Genus MESIRA Börner, 1903; Handschin, 1925; nec. Schtscherbakow, 1898.

MESIRA CALOLEPIS Börner, 1913.

Description.—Length, to 2·5 mm. Colour, in immature forms entirely yellowish, in adults with bluish pigment on side of thorax II., III., and abdomen I. with narrow bluish bands. Antennae three times as long as head, segment IV. weakly ringed and with apical sensory knob. Claws with three inner teeth and outer lateral tooth. Empodial appendage narrow with more or less truncate apex. Mucro bidentate with basal spine.

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[1] *P. alba* (Pack.) has not yet occurred in Australia, but as specimens have recently been seen from Auckland, New Zealand, it is included in the key.

This species was originally described by Börner and later redescribed by Handschin, both from material from Java. In Australia I took several specimens from under stones at Mullewa, Western Australia, in September, 1931.

MESIRA FLAVOCINCTA (Schött, 1917). (Text fig. 14, *a.-c.*)

= *Lepidocyrtoides flavocinctus* Schött, 1917.

Description.—Length, 2-5 mm. Antennae two-thirds as long as body; segment IV. ringed. Thorax II. comparatively slightly overhanging head and about twice as long as III. Abdomen IV. four times as long as III. Ocelli, 8 on each side, unequal. Tibiotarsal spur hair hardly as long as claw. Claw with four

Fig. 14.

a. *Mesira flavocincta v. unicolor*, n. v. Entire animal.
b. " " " " " Claw, empodial appendage, and tip of tibiotarsus.
c. " " " " " Mucro and tip of dens.
d. *Lepidocyrtus nigrofasciata*, n. sp. Entire animal, without scales or hairs.
e. " " " Claw, empodial appendage, and tip of tibiotarsus.
f. " " " Mucro and tip of dens.

inner teeth. Empodial appendage pointed. Unringed portion of dens twice as long as mucro. Mucro bidentate with basal spine. Scales pointed or rounded with moderately long striations.

This is a common species in Western Australia, and I have seen specimens from Tasmania. The specimens nearest to the typical form as described by Schött have not the entirely white band on abdomen I. but also a little blue on this segment; the anterior part of abdomen IV. is also whitish. The majority of Western Australian specimens, however, are almost entirely blue-pigmented, except for a few light dorsal streaks. For this form I suggest the name **unicolor, n. var.**

Schött's figure shows the insect to have a characteristic convex curvature to the body. In most of my Western Australian specimens this is also the case, but in some the dorsal curvature is concave so that the mesonotum appears to be more overlapping the head than in the others. The appearance of the latter rather suggests the form of *Lepidocyrtoides,* and at first I was disposed to consider these as *Lepidocyrtoides cucularis* Schött.

Localities.—Picton Junction, Western Australia, October, 1930 (H. W.); Guildford, Western Australia, October, 1930 (H. W.); Wembley, Western Australia, November, 1930 (H. W.); Perth, Western Australia, November, 1930 (H. W.); Parkerville, Western Australia, October, 1930 (H. W.); Lesmurdie, Western Australia, October, 1930 (D. C. S.); Cascades, Tasmania, August, 1932 (V. V. H.).

MESIRA AUSTRALICA (Schött, 1917).

= *Lepidocyrtoides australicus* Schött, 1917.

Description.—Length, 3·5-5·0 mm. Colour, yellowish white, front of mesothorax and sides of body segments with bluish pigment, laterally on top of segments also with bluish stripes. Ocellar patches joined by a blue line between antennae. Antennae and appendages with bluish rings. Antennae two-thirds as long as body, IV. distinctly annulated and with terminal knob. Mesonotum only slightly overlapping head, twice as long as metanotum. Abdomen IV. from 4 to 6 times as long as III. Ocelli, 8 on each side, anterior pair large. Tibiotarsal spur hair shorter than claw. Claw with lateral tooth, proximal double tooth and two distal teeth. Unannulated portion of dens twice as long as mucro. Mucro bidentate with basal spine.

Localities.—Government House Lake, Rottnest Island, Western Australia, 1930 (L. J. G.); Belgrave, Victoria, 1931 (H. G. A. and H. F. D.); Sherbrook, Victoria, April, 1931 (H. G. A.); Morialta, Adelaide, South Australia, August, 1933 (H. W.); Victor Harbour, South Australia, January, 1934 (H. W.); Forest Hill, Queensland, December, 1932 (A. R. B.).

Remarks.—All the material that I have seen has been of the typical form as described by Schött. In his original description Schött does not mention the annulation of the IVth antennal segment. This is, however, in all my material very distinct and, therefore, the species is here placed in the genus *Mesira.*

Mesira fasciata, n. sp. (Text fig. 13, *j.-o.*)

Description.—Length, 3·0 mm. Colour, without scales, dirty yellow with black eye-patches, a black band posteriorly on abdomen II. and entirely on III., tip of V. and VI. dark, venter of abdomen, femur III. and tibiae dark blue, antennae III. and IV. bluish darker at bases and apex of III. Ocelli, 8 on each side. Antennae half as long as the body, ratio of segments = $1\frac{1}{8}$: 2 : $2\frac{1}{3}$: 4, IV. annulated with apical knob, I. and II. scaled. Mesonotum slightly overhanging head, ratio of head: th. II. : III. : abd. I. : II. : III. : IV. : V. : VI. = $3\frac{1}{2}$: $2\frac{3}{4}$: $1\frac{3}{4}$: 1 : 1 : 1 : $5\frac{1}{2}$: $1\frac{1}{2}$: 1. On the posterior edge of head where it joins the mesonotum is a collar of small spines. Furca long, ratio of manubrium to mucrodens = $3\frac{1}{2}$: $5\frac{1}{2}$, mucro bidentate with basal spine, about one-third as long as unannulated portion of dens. At apex of manubrium are a few long setae. Dentes scaled. Legs long, tibiae with false joint, claws strong with outer lateral tooth and three inner teeth, one basal and two distal, empodial appendage long and simple as figured. Spathulate tibiotarsal hair present. Body scaled, scales brownish, obtusely pointed with distinct short striations.

Locality.—In debris, Brisbane, Queensland, May, 1933 (A. R. B.).

Syntypes in South Australian Museum.

Key to the Australian Species of Mesira.

1. Antennae longer than the body. Colour, whitish. Claw long and narrow, with one basal tooth and one very distal tooth on inside. *M. longicornis* (Schött).[a]

   Antennae shorter than the body. 2
2. Species of a light yellowish colour, sometimes with bluish pigment laterally. *M. calolepis* Börner.

   Species almost entirely pigmented or with lateral longitudinal marks or with cross-bands. 3
3. Species with cross-band on abdomen II. and III. *M. fasciata*, n. sp.
   Species not as above. 4
4. Species almost entirely bluish pigmented with only light longitudinal streaks, sometimes abdomen I entirely white. *M. flavocincta* (Schött).

   Species yellowish with bluish longitudinal markings laterally and dorsally. *M. australica* (Schött).

Genus Lepidocyrtus Bourlet, 1839; Handschin, 1925.

Syn. = *Podura* Linne, 1767 (ad partem); *Poidium* Koch, 1840; *Cyphodeirus* Nicolet, 1841 (ad partem).

This genus in a strict sense is defined by Handschin, 1925 (17) as possessing hyaline scales without long striations or faint short markings, unarmed dentes, claws without wing-like basal teeth, unannulated antennae and bidentate mucro with basal spine. Schött, in his paper on the Australian forms, gives the absence of the terminal knob on the fourth antennal segment as also characteristic. Of this genus only the first two of the following species have been previously recorded from Australia.

Lepidocyrtus praecisus Schött, 1917.

Description.—Length, 1·0 mm. Colour, blue, antennae and legs blue, furca yellowish. Antennae slightly longer than the head. Claws long and narrow with only a proximal double tooth. Empodial appendage truncate apically.

Since Schött recorded this species from North Queensland specimens have been taken in sweepings at Urrbrae, South Australia, in October, 1929 (D. C. S.), and in the hot-house of Government House, Perth, Western Australia, in February, 1931. It has also been found in the You Yang Mountains, Victoria, in September, 1931 (J. W. R.).

Lepidocyrtus ralumensis Schäffer.

Description.—Length, 1·0 mm. Colour (in spirit, yellowish) in life said to be "snow white." Antennae bluish, slightly longer than head. Claws strong with two inner teeth and outer lateral tooth. Empodial appendage lanceolate, not apically truncate. Spathulate tibiotarsal hair short and fine.

Schött recorded this species from Queensland, and specimens have been received from Miss J. W. Raff taken in the You Yang Mountains, Victoria, in September, 1931.

Lepidocyrtus cyaneus Tullberg, 1871.

= *Lepidocyrtus purpureus* Lubbock, 1873; *L. violaceus* Lubbock, 1873; *L. assimilis* Reuter, 1890; *L. metallicus* MacGillivray, 1891; *L. elegantulus* Meinert, 1890; *L. anglicanus* Jackson, 1926.

Description.—Length, to 1·5 mm. Iridescent dark blue or violet. Claw with strong lateral tooth and two inner teeth. Empodial appendage lanceolate and simple.

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[a] In his paper of 1925 (29) Schött was uncertain of the correct position of his *Lepidocyrtoides longicornis*. The annulated antennae will, however, place it in the genus Mesira as understood here.

This European species is almost cosmopolitan in its distribution. It occurs commonly on cultivated ground around Perth, Western Australia, and around Adelaide, South Australia.

Lepidocyrtus nigrofasciatus, n. sp. (Text fig. 14, *d.-f.*)

Description.—Length, 0·9 mm. Colour, yellow with deep blue pigment on mesothorax, metathorax and first three abdominal segments. The basal segments of the legs, a patch between the antennae bases and the antennae light blue. Antennae as long as the head, ratio of segments = 12 : 15 : 15 : 26. Furca long, ratio of manubrium to mucrodens = 5 : 4. Body densely haired and scaled. Scales brownish but without striations or marks. Claws with lateral teeth only. Empodial appendage parallel-sided and apically truncate. Mucro normal with two teeth and basal spine.

Locality.—Kalorama, Mount Dandenong, Victoria, in June, 1932 (J. W. R.); Mount Osmond, June 6, 1934 (H. W.); Botanic Gardens, Adelaide, June, 1934 (H. W.).

Syntypes in the South Australian Museum.

Remarks.—This species is very closely related to *L. instratus* Handschin, from the Swiss National Park, but is specifically distinct in the presence of lateral teeth to the claws as well as in the greater extent of the pigmentation. The blue pigment is sometimes lighter on th. II. to abd. II., and in the specimens from the Botanic Gardens it is entirely absent, the insects being entirely yellow. To this form I give the name of var. **aureus**, v. n.

KEY TO THE AUSTRALIAN SPECIES OF LEPIDOCYRTUS.

1.	Empodial appendage truncate apically.	2
	Empodial appendage not apically truncate.	3
2.	Colour yellow with blue pigment on th. II., abd. I., II, and III. Claw with lateral teeth Sides of empodial appendage parallel.	*L. nigrofasciatus*, n. sp
	Entirely blue pigmented species. Empodial appendage with divergent sides	*L. praecisus* Schött.
3.	Colour in life bluish iridescent.	*L. cyaneus* Tullberg.
	Colour in life snow-white.	*L. ralumensis* Schäffer.

Genus LEPIDOSIRA Schött, 1925.

Schött erected this genus in 1925 (29) for several species which in 1917 (28) he had included in his heterogeneous genus *Lepidocyrtoides*. He specially named *L. australicus*, *L. sagmarius*, *L. coeruleus*, and *L. cinctus*, as being species of *Lepidosira*. As type of his *Lepidocyrtoides* he retained *L. cucularis*, and also included his *L. striatus* from New Guinea. Of the remaining species he would not express any definite opinion of *L. longicornis*, *L. flavocinctus* and *L. angulatus* (misspelt *angustatus* in his 1925 paper). *L. spinosus* had already been transferred to a new genus *Acanthocyrtus* by Handschin (17). In this paper it is shown that *L. australicus* and *L. flavocintus* are properly included in the genus *Mesira*, and it is here suggested that from Schött's description and figures *L. longicornis* will also probably fall into the same genus.

In 1927 Schött again discussed the genus *Lepidocyrtus* and redefined it on characters quite the opposite to those of his original diagnosis. This inconsistency I have discussed elsewhere (34). The genus *Lepidocyrtoides*, as originally defined, with *L. cucularis* Schött as the genotype, can be separated from *Lepidosira* by the very much longer mesonotum, compared with the metanotum, and by this segment very much overlapping the head.

The only species of *Lepidosira* that I have been able to examine is the following:—

LEPIDOSIRA COERULEUS (Schött, 1917).

= *Lepidocyrtoides coeruleus* Schött, 1917.

Description.—General facies of *Sira*-type. Length, 2-3 mm. Colour generally blue with the lighter ground showing through as spots on thorax II. and abdomen III. Antennae lightly pigmented, twice as long as head, IV. with terminal sensory knob. Mesothorax slightly overhanging head, distinctly longer than metathorax. Abdomen IV. from 3½ to 4 times as long as III. Ocelli, 8 on each side, the proximal elements smaller. Tibiotarsal spur hair shorter than claw. Claw with lateral tooth and four inner teeth, the proximal pair in middle of inner edge. Empodial appendage lanceolate. Dentes with lancet-like ciliated scales ventrally. Mucro bidentate with basal spine.

Localities.—Originally from Queensland, this species can now be recorded from Muresk, Western Australia, October, 1930 (H. W.); Armadale, Western Australia, June, 1932 (G. E. N.); Gooseberry Hill, Western Australia, June, 1932 (G. E. N.); Muresk, Western Australia, 1932 (H. G. A.).

Genus ACANTHOCYRTUS Handschin, 1925.

ACANTHOCYRTUS SPINOSUS (Schött, 1917). (Text fig. 15, *e.*)

= *Lepidocyrtoides spinosus* Schött, 1917.

Description.—Length, 3·0 mm. Colour entirely bluish-black, but in life often showing silvery cross-striations which vary and are apparently due to reflection. Antennae and furca light. Antennae two-thirds of body length, IV. with terminal knob. Mesothorax slightly overhanging head, twice as long as meso-

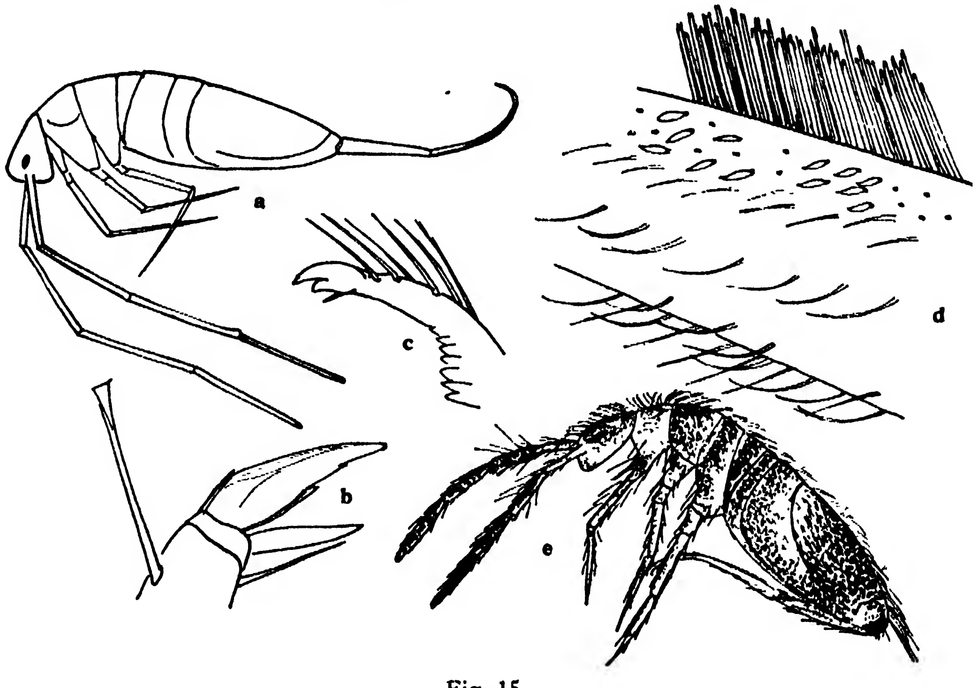

Fig. 15.

a.	*Acanthocyrtus lineatus*, n. sp.	Entire animal in outline.
b.	„ „ „	Claws, empodial appendage and tip of tibiotarsus.
c.	„ „ „	Mucro and tip of dens.
d.	„ „ „	Dental spines.
e.	*Acanthocyrtus spinosus* (Schött.)	Entire animal.

thorax. Abdomen IV. from two and a half to five times as long as III. Ocelli, 8 on each side, proximal smaller. Tibiotarsal spur hair shorter than claw. Claw with lateral tooth, proximal double teeth and one distal tooth. Empodial appendage lanceolate. Manubrium one-third longer than mucrodens. Dentes with many rows of spines and long setae. Long ciliated hairs on apical tergites of abdomen. Antennal segments with few pointed setae. Scales hyaline and striated.

Localities.—This species was first recorded by Schött from Queensland as *Lepidocyrtoides spinosus* and later placed by Handschin in a new genus *Acanthocyrtus* because of the distinctly spined dentes. It is very common and widely distributed in cultivated areas in the southern parts of both Western Australia and South Australia.

Acanthocyrtus lineatus, n. sp. (Text fig. 15, *a.-d.*)

Description.—Length, 4·0 mm. Ground colour yellowish with dark lateral stripes from head to base of abdomen IV., a few other markings laterally. Antennae dark, femora with a bluish-black subapical band, tibiotarsi with two bands, furca light. Antennae longer than body, ratio of segments = 2½ : 3¾ : 3-3½ : 5; IV. annulated with apical sensory knob. Ocelli, 8 on each side in two parallel rows on dark field. Ratio of th. II. : III. : abd. I. : II. : III. : IV. : V. : VI. = 3½ : 3½ : 2⅓ : 1⅓ : 2 : 1⅔ : 7 : 1 : ½. Ratio of manubrium to dentes and mucro = 5 : 6 : 0·15; furca reaching ventral tube. Claws as figured. Dens with several rows of short stout spines and long ciliated setae. Mucro bidentate with basal spine, half the length of the unannulated portion of dens. Scales obtusely pointed, distinctly but not long striated.

Locality.—Among decaying leaves at Brisbane, Queensland, in September, 1932 (A. R. B.).

Syntypes in the South Australian Museum.

Remarks.—This species differs from the preceding in colour, length of antennae and other morphological details.

Subfamily PARONELLINAE Börner, 1906.

Genus Pericrypta Ritter, 1910.

This is a scaleless genus with a typical Paronelline mucro and closely allied to the genus *Salina* MacGillivray (= *Cremastocephalus* Schött). It differs in the structure of the mucro, the absence of the apical lobe of the dentes, the empodial appendage and the parallel arrangement of the ocelli. The body is humped generally and not locally as in *Campylothorax* Schött.

Pericrypta mjöbergi Schött, 1917.

Description.—Length, 2·0 mm. Colour, yellowish-white with deep blue markings as in Schött's figure. Antennae as long as body, ratio of segments = 1 : 1½ : 1¼ : 1¾-2, antennae IV. with pointed sensory setae. Mesonotum a little longer than metanotum. Ratio of abdomen III. : IV. = 1 : 3¾-5. Ocelli, 8 on each side, proximal smaller. Tibiotarsal spur hair as long as claw, curved and spathulate. Claw with lateral teeth, double proximal tooth in the middle of inner edge and two distal inner teeth. Empodial appendage lanceolate. Mucrodens one and a half times as long a manubrium. Mucro with two teeth. Fine ciliated sensory setae on abdomen III. and IV.

Localities.—Originally described from Queensland, this species has been received from Adelaide, South Australia, in November, 1931, from under stones (D. C. S.); in moss, Cascades, Tasmania, in August, 1932 (V. V. H.).

Pericrypta dandenongensis, n. sp. (Text fig. 16, *a.-c.*)

Description.—Length, 1·3 mm. Colour, yellowish with blue-black pigment on metathorax; abdomen I., II. and III. dorsally. Base of antennae II. and III. also blue pigmented. The head between the ocelli and lightly on the middle of antennae I., II. and base of IV. reddish-brown. Antennae longer than body, ratio of segments = 16 : 26 : 20 : 35. Ratio of manubrium to mucrodens = 20 : 40, mucro with two teeth. Clothing of long clavate ciliated setae on dorsum and long pointed sensory setae on antennae. Claws as figured.

Locality.—A single specimen from Kalorama, Mount Dandenong, Victoria, in May, 1932 (J. W. R.).

Type in the South Australian Museum.

Pericrypta lineata, n. sp. (Text fig. 16, *d.-f.*)

Description.—Length, 4·5 mm. Colour, yellow, except for a small bluish spot between the ocellar fields, and an irregular bluish mid-dorsal line. Antennae long, I. and II. together three times as long as head (III. and IV. wanting). Ratio of

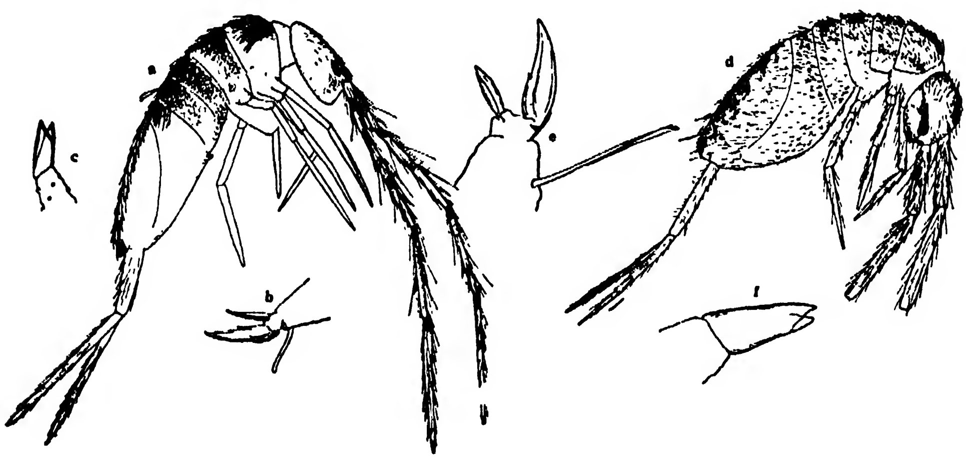

Fig. 16.

a. *Pericrypta dandenongensis*, n. sp. Entire animal.
b. " " " Claw, empodial appendage and tip of tibiotarsus.
c. " " " Mucro.
d. " *lineata*, n. sp. Entire animal.
e. " " " Claw, empodial appendage and tip of tibiotarsus.
f. " " " Mucro.

antennal segments = 25 : 35 : ? : ?. Ocelli, 8 on each side. Claws strongly curved with two fine inner teeth, one before the middle, the other more distal; lateral teeth present but small, claw half as long again as the mucro. Empodial appendage simple, lanceolate. Furca long, ratio of manubrium to mucrodens = 3 : 4, mucro with two teeth. Clothing typical but with only a few strong abdominal setae.

Locality.—In moss, Trevallyn, Tasmania, in August, 1929 (V. V. H.).

Type in the South Australian Museum.

Remarks.—This species differs from the two preceding forms in the colour, dentition of the claws, and in the lack of strong setae on the abdominal segments, although it is possible that some of the last may have become lost.

Genus PSEUDOPARONELLA Handschin, 1921.

The old genus *Paronella* was very thoroughly revised by Handschin in 1921, so that the only two species hitherto known from Australia, *P. appendiculata* Schött and *P. queenslandica* Schött, must now be placed in *Pseudoparonella.* This genus is characterised by the mucro having only two teeth.

PSEUDOPARONELLA APPENDICULATA (Schött, 1917).

= *Paronella appendiculata* Schött, 1917.

Description.—Colour, yellowish, with dark pigmentation on the sides and top of body. Antennae bluish. Mucro small. Claw with two distal inner teeth.

Locality.—Specimens referable to this species have been collected at Lesmurdie, Western Australia, in October, 1930 (D. C. S.).

Fig. 17.

a. *Pseudoparonella halophila*, n. sp. Entire animal from side.
b. " " " Hind foot.
c. " " " Mucro and tip of dens.

Pseudoparonella halophila, n. sp. (Text fig. 17, *a.-c.*)

Description.—Length, 2·0 mm. Colour, whitish-yellow, except for the black ocellar patches and a black spot between the antennal bases. Antennae nearly three times the head length, ratio of segments = 10 : 16 : 13 : 22. III. and IV. bluish. Mesothorax one-third as long again as the metathorax. Furca long, reaching ventral tube, ratio of manubrium to mucrodens = 23 : 28, mucro with two teeth and one-third the length of hind claw. Claw with two prominent inner teeth. Ocelli, 8 on each side. Empodial appendage lanceolate with broad inner and outer lamellae.

Localities.—Type from Lake Herschel, Rottnest Island, Western Australia, in December, 1930 (L. J. G.); other specimens from amongst debris on shore of harbour at Albany, Western Australia, in October, 1930 (H. W.).

Remarks.—Differs from *appendiculata* Schött in the length of the antennae and the dentition of the claws, etc.

Type in the South Australian Museum.

Subfamily CYPHODERINAE Börner, 1906.

Genus CYPHODERUS Nicolet, 1841.

Syn. *Beckia* Tömösvary, 1882; *Boreus* Folsom, 1923.

CYPHODERUS SERRATUS Schött, 1917.

Description, 1·0-1·25 mm. Colour, white. Antennae one-third longer than the head, ratio of segments = 1 : $2\frac{1}{2}$: $1\frac{1}{2}$: $4\frac{1}{2}$, IV. with pointed sensory setae. Mesonotum slightly overhanging the head and distinctly longer than the metanotum. Abdomen IV. from 4 to 5 times as long as III. Ocelli absent. Post-antennal organ absent. Claw with lateral teeth and three inner teeth, including the two proximal wing-teeth of different size, and a strong distal tooth. Empodial appendage with large outer wing-like tooth. Ratio of manubrium : dentes : mucro = 1 : 2 — $2\frac{1}{3}$: $2\frac{3}{4}$-4. Mucrones dorsally with a series of strong teeth, 9-13 in number. Large distal outer scale of dens reaching to $\frac{4}{5}$ of mucro.

This species was described by Schött from Queensland material. It occurs widely in both Western and South Australia and is associated with ants and termites.

CYPHODERUS BIDENTICULATUS Parona, 1888. (Text fig. 18, *a.-c.*)

Description.—Length, 1·6 mm. Colour, white. Ocelli absent. Antennae half as long again as the head, ratio of segments = $1\frac{1}{2}$: 3 : $1\frac{1}{2}$: 4. Claws with large and prominent unequal wing-like proximal inner teeth and one very indistinct distal tooth. Empodial appendage slightly over-reaching the larger basal tooth of claw and with the usual outer wing-like tooth. Furca nearly half as long as body, ratio of manubrium : dens : mucro = 7 : 4 : 2; mucro with two sub-apical teeth besides the apical one. Dens with a double row of 6-7 ciliated scales,

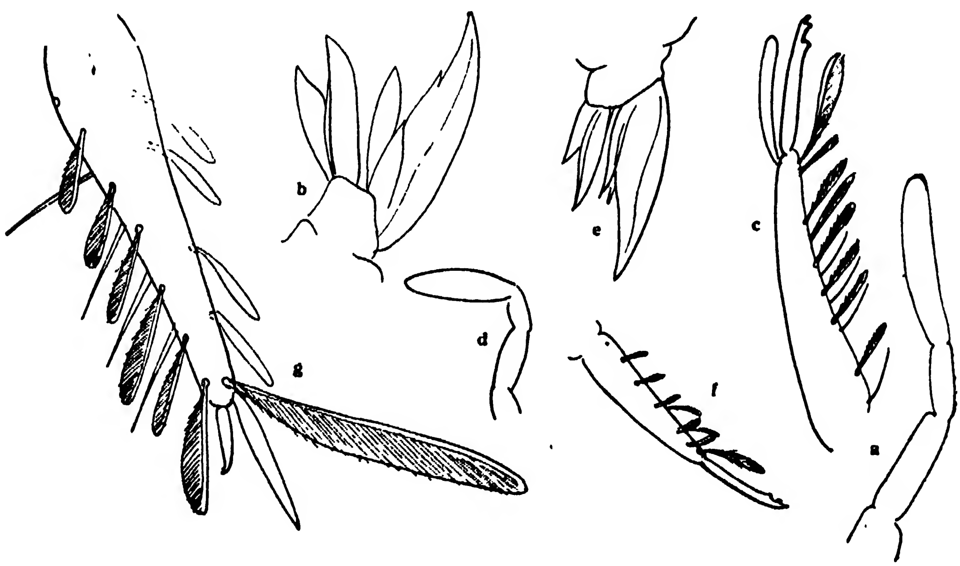

Fig. 18.

a.	*Cyphoderus bidenticulatus* Paron.		Antenna.
b.	" " "		Foot.
c.	" "		Mucro and dens.
d.	*adelaideae,* n. sp.		Antennae.
e.	" "		Foot.
f.	" "		Mucro and dens.
g.	*nichollsi,* n. sp.		Mucro and dens.

the apical outer scale almost reaching the tip of mucro, the inner one slightly shorter.

This species is known from Europe and Natal and is closely related to the European *C. albinos,* which has only one subapical tooth to the mucro.

Locality.—Glen Osmond, South Australia, 1933, in garden soil associated with ants.

Cyphoderus adelaideae, n. sp. (Text fig. 18, *d.-f.*)

Description.—Length, 1·4 mm. Colour, white. Ocelli absent. Antennae only slightly longer than the head, ratio of segments = 1 : 2 : 1 : 3. Claws with two strong inner basal teeth, practically equal and wing-like; no distal inner tooth? Empodial appendage normal, apically truncate and reaching beyond basal teeth of claw. Furca short and stumpy, one-third of body length, ratio of manubrium : dentes : mucro = 6 : 3 : 1½, dens with two rows of ciliated scales, five on the inner row and only three larger ones on the outer row, apical outer scale reaching to proximal tooth of mucro. Mucro distinctly curved dorsally, with two subapical teeth besides the apical one.

Localities.—Burnside, South Australia, May, 1933, with termites (H. W.); Brown Hill Creek, South Australia, August, 1933, with termites (H. W.).

Syntypes in the South Australian Museum.

Remarks.—This species is rather closely related to the preceding but differs in the length and stoutness of the furca, the dental scales and the dentition of the claws.

Cyphoderus nichollsi, n. sp. (Text fig. 18 *g.*)

Description.—Length, 0·9 mm. Colour, yellowish-white. Ocelli absent. Antennae slightly longer than the head, ratio of segments = 1 : 3 : 1½ : 4. Claw with two prominent but slightly unequal inner basal teeth; distal inner teeth (?) Empodial appendage normal, not truncate apically. Furca short, ratio of manubrium : dentes : mucro = 3½ : 3 : ½, dens with two rows of ciliated scales, 6-7 in each row and about equal in length in each row, the outer distal scale is five times as long as the mucro. Mucro very short and simple, without teeth other than the slightly upturned apex. Inner apical scale of dentes two and a half times the length of mucro.

Locality.—This species was found along with ants at Kalamunda, Western Australia, in June, 1932, by Prof. G. E. Nicholls, after whom it is named.

Type in the South Australian Museum.

Remarks.—Distinctly different from other species in the structure of the mucro.

Key to the Australian Species of Cyphoderus.

1. Mucro small, only one-fifth the length of dentes. Inner and outer scale at apex of dentes from 2½-5 times as long as mucro. Mucro without teeth. *C. nichollsi,* n. sp.
   Mucro considerably larger. 2
2. Mucro with a series of from 9-13 strong teeth. Mucro about one-fifth longer than outer apical dental scale. *C. serratus* Schött.
   Mucro with only one or two subapical teeth. 3
3. Mucro fairly long and narrow with two small teeth, one subapical and one apical, somewhat S-shaped and slightly longer than the outer apical dental scale. *C. pseudalbinus* Schött.
   Mucro otherwise, with three teeth, two subapical and one apical. 4
4. Mucro dorsally curved. Dentes with inner row of five short ciliated scales and outer row of three larger scales. Outer distal scale of dentes not quite reaching the proximal tooth of mucro. Claw with two subequal inner basal teeth, no distal inner tooth. *C. adelaideae,* n. sp.

Mucro dorsally practically straight. Dentes with two rows of 6-7 ciliated scales of equal length. Both inner and outer distal scales of dentes almost reaching tip of mucro. Claw with two prominent but very unequal inner basal teeth and an indistinct inner distal tooth.

C. bidenticulatus Parona.

Key to the Superfamily Entomobryoidea (Collembola-Arthropleona).

A. Trochanteral organ, consisting of an area of fine hairs on hind coxae, absent. Ventral edge of claw without groove.

I. Abd. III. and IV. subequal, sometimes IV. slightly longer. With or without scales, if present then these entirely without longitudinal striae. Abdominal sensory hairs present or absent.
Family ISOTOMIDAE Schäffer, 1896; Börner, 1903.

(a) Head hypognathus. Antennae inserted in middle of head. Tracheae present. Furcal segment with two stout chitin ridges.
Subfamily ACTALETINAE Börner, 1906.
Single genus *Actaletes* Giard, 1889
(not Australian)

(a′) Head prognathus. No tracheal system. Antennae inserted in front half of head. Furcal segment without chitin ridges. Furca seldom absent. Postantennal organ mostly present.

(b) Scales present. Postantennal organ present, rosette like. Mucro long with many teeth, without hairs.
Subfamily ONCOPODURINAE Börner, 1906.
Single genus *Oncopodura* Carl and Lebedinsky, 1905
(not Australian).

(b′) Scales absent. Postantennal organ when present simple. Mucro short.
Subfamily ISOTOMINAE (Schäffer, 1898; Börner, 1913).

(c) Anus ventral, the opening being beneath or at least obliquely behind and beneath *(Folsomia)*, not terminal. Subapical papillae of antennae present or absent. Genital and anal segments large. Dorsum smooth or granular. Anal spines present or absent.
Tribe Anurophorini Börner, 1905.

1. Anal spines present on abd. V. or VI. — 2
Anal spines absent. — 4

2. Anal spines on abd. V. as a crown of 15-30, not on distinct papillae. Dens and mucro fused.
Genus *Proctostephanus* Börner, 1906
(not Australian).
Anal spines on abd. VI. — 3

3. Anal spines 2, small. Empodial appendage absent. Ocelli, 8 on each side. Furca absent.
Genus *Uzelia* Absolon, 1901.
= *Pentapleotoma* Börner, 1903
= *Protanurophorus* Womersley, 1926
(not Australian).
Anal spines 4, large. Empodial appendage present. Ocelli, 8 on each side. Furca present or absent.
Genus *Tetracanthella* Schött, 1891
(not Australian).

4. Furca present, even if partially reduced. — 8
Furca absent or only represented by papillae. — 5

5. Furca represented by papillae. — 6
Furca entirely absent. — 7

6. Integument honeycombed. No clavate tibiotarsal hairs.
Genus *Paranurophorus* Denis, 1928
(not Australian).
Integument very granular. Furcal papillae with two short chitinous salient edges. Empodial appendage and tibiotarsal clavate hairs present.
Genus *Bornerella* Denis, 1925
(not Australian).

7. Anal papilla present. Terminal knob on antennae IV. absent. Long in form, resembling *Folsomia*. Ocelli reduced.

Genus *Pseudanurophorus* Stach. (not Australian).

Anal papillae absent. Otherwise not as above.

Genus *Anurophorus* Nicolet, 1841 (not Australian).

8. Abd. VI. more or less concealed under V. or IV. to VI. fused. 9
Abd. with all segments distinctly visible from above and separated. Furca well developed and normal. Postantennal organ present. Ocelli, 6 on each side.

Genus *Astephanus* Denis, 1926 (not Australian).

9. Abd. VI. concealed under V. Genus CRYPTOPYGUS Willem, 1906.
Abd. IV. to VI. fused 10

10. Anus distinctly ventral. Ocelli absent. Body elongate. Furca short.

Genus ISOTOMODES Axelson, 1907.

Anus not distinctly ventral, almost terminal. Ocelli reduced or absent. 11

11. Mucro falciform. Ocelli and postantennal organ absent. Antennae IV. with 5-6 large sensory clubs or two broad sensory lobes.

Genus FOLSOMINA Denis, 1931, inc. DENISIA Folsom, 1932.

Mucro dentate. Postantennal organ present. Ant. IV. normal. Ocelli reduced or absent. Genus FOLSOMIA Willem, 1902.

(c′) Anus terminal. Anal segment seldom fused to genital. Anal spines present or absent. Empodial appendage and furca usually present.

Tribe ISOTOMINI Börner, 1913.

1. Body form elongate and cylindrical. Dens and mucro not separated. Mucro bidentate. Postantennal organ long and narrow. Ocelli present.

Genus *Folsomides* Stach, 1922 (not Australian).

Body form otherwise. 2

2. With fine sensory hairs (Bothriotricheae) on abdominal segments. 3
Without these. 8

3. Dentes with simple or serrated spines. 4
Dentes without spines. 5

4. Spines on dentes serrated. Genus **Acanthomurus**, n. gen.
Spines on dentes simple but on distinct papillae or tubercles.

Genus **Proisotomurus**, n. gen.

5. Build peculiar. Antennae III. and VI. elliptical and annulated. Ocelli, 6 on each side. Postantennal organ present. Mucro with 3 teeth. Trochanteral organ?

Genus *Architomocerura* Denis, 1931 (not Australian).

Not as above. 6

6. Antennae III. normal, II. with 15-20 sensory rods. Claw outside with a pair of long filaments. Littoral species.

Genus AXELSONIA Börner, 1907.

Antennae III. normal. 7

7. Mucro with 3 teeth, the proximal two as a pair side by side and basal. Femora III. with a pointed process.

Genus *Archisotoma* Linnaniemi 1912 (not Australian).

Mucro normal with 4 teeth. Femora III. normal.

Genus ISOTOMURUS Börner, 1903.

8. Species with clavate ciliated hairs on thoracic and abdominal segments as in Entomobrya. Abd. IV. little or much longer than III. Postantennal organ absent. 9

Species without such clavate hairs. Abd. IV. only slightly longer than III. Postantennal organ present or absent. 10

9. Mucro bidentate. Abd. IV. never much longer than III. Tibiotarsus without clavate hairs. Genus *Corynothrix* Tullberg, 1872 (not Australian).

Mucro falciform. Abd. IV. three times as long as III. Tibiotarsus with three clavate hairs. Genus **Isotobrya**, n. gen.

10. With feathered but not clavate hairs on thoracic and abdominal segments. Without scales. 11
Not as above. 12

11. Dentes without spines. Abd. IV. with two very long dorsal hairs. Genus *Alloschaefferia* Börner, 1903. (not Australian).

Dentes spined. Abd. IV. without excessively long hairs. Mucro 4-toothed, indistinctly separated from dens. Genus *Tomocerura* Wahlgren, 1900. (not Australian).

12. Species strongly sexually dimorphic. Males always with more than long ciliated hairs on abdominal segments, which are not present in the female. 13

Species in males at most with long ciliated hairs on abdominal segments, which are not present in the females. 14

13. Male with lateral processes on abd. IV. Genus *Guthriella* Börner, 1906 (not Australian).

Male with long curved horns on head. Genus **Rhodesia**, n. gen.[a] for *Vertagopus minos* Den. (not Australian).

Male with chitinous spines on abd. V. 14

14. Species with 4 stout spines on papillae on abd. V. Genus SPINISOTOMA Stach., 1926

Species without anal spines. 15

15. Abd. IV. equal to or shorter than III. 17
Abd. IV. longer than III. 16

16. Tibiotarsus with a single broadly spathulate tenent hair. Genus *Pteronychella* Börner, 1909. (not Australian).

Not as above. Genus PROISOTOMA Börner, 1906.

† Abd. V. and VI. separated. Subgenus PROISOTOMA s. str. Börner, 1906.

‡ Abd. V. and VI. fused. Subgenus ISOTOMINA Börner, 1903.

17. Claw with basal tunica. Mucro short, bidentate, with long setae overlapping it. Genus *Agrenia* Börner, 1906 (not Australian).

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[a] In his recent paper on the South African Collembola (34) the writer recorded *Isotoma (Vertagopus) minos* from Southern Rhodesia. This species, originally recorded by Denis from Italian Somaliland, was placed under *Vertagopus* by Denis because of the clavate tibiotarsal hairs. It differs remarkably, however, in the ornamented armature of the male sex, and the writer now proposes the generic name of *Rhodesia* for it. The specialized secondary horns and hairs of the male seem to justify this, as in the case of Börner's genus *Guthriella* erected for *Isotoma muskegis* Guthrie.

Claw without basal tunica. No seta overlapping mucro. Tibiotarsal clavate hairs present or not.

Genus ISOTOMA (Bourlet, 1839) Börner, 1906.

† Tibiotarsal clavate hairs present.

1. Abd. V. and VI fused. Furca reaching ventral tube. Mucro with three teeth. Subgenus *Pseudisotoma* Handschin, 1924 (not Australian).

2. Abd. V. and VI. free. Furca only reaching back edge or abdomen II. Mucro 4-toothed.

Subgenus *Vertagopus* Börner, 1906 (not Australian).

‡ Tibiotarsal clavate hairs absent. Furca reaching ventral tube.

Subgenus ISOTOMA s. str. Börner, 1906.

II. Abd III. longer than IV., all tergites free. With or without scales, if present then with longitudinal ribs. Postantennal organ absent. Ciliated sensory setae present on abdominal segments or not. Furca present. Family TOMOCERIDAE (Schaffer, 1896).

(a) Dentes at least indistinctly annulated. Mucro small, unhaired. Antennae III. not greatly longer than IV. Subfamily LEPIDOPHORELLINAE Börner, 1906.

(b) Without scales. Mucro as in Isotomurus, small. Antennae III. and IV. and distal part of II. annulated. Dentes without spines.

Tribe **Neophorellini** n. tr.
Single genus *Neophorella* Womersley, 1933 (not Australian).

(b') Scales present. Mucro falciform. Antennae not annulated.

Tribe **Lepidophorellini** n. tr.
Single genus Lepidophorella Schäffer.

(a') Dentes not annulated, 2-segmented. Mucro long, haired. Antennae III. much longer than IV. Subfamily TOMOCERINAE Börner, 1906.

1. Ocelli present, 6 on each side. Tibiotarsal clavate hair present.

Genus *Tomocerus* Nicolet, 1841 (not Australian).

† Head of maxillae without beard. Subgenus TOMOCERUS s. str. Börner, 1908

‡ Head of maxillae with beard. Subgenus POGONOGNATHUS Börner, 1906.

Ocelli and tibiotarsal clavate hair absent.

Genus *Tritomurus* Frauenfeld, 1854 (not Australian).

B. Trochanteral organ present on leg III Ventral edge of claw generally with basal groove. Hairs and scales often ciliated. Abd. IV as a rule longer than III. Furca present.

Family ENTOMOBRYIDAE Schäffer, 1896.

1. Dentes slender, annulated. Mucro small. With or without scales or ocelli.

Subfamily ENTOMOBRYINAE Börner, 1906.

(a) Antennae 4-segmented. Tribe ENTOMOBRYINI Börner, 1906.

1. Body entirely without scales. 2
   Body scaled. 5

2. Body strongly convex. Furca reaching to below the head. Mucro simple, not hook-like, not distinct from dens. Antennae much longer than body.

Genus COELURA Schött, 1917.

Body normal. Furca shorter, mucro distinct and normal. 3

3. Claws with wing-like basal tooth. Clavate tibiotarsal hair present but weak. Tibiotarsus inside with double row of naked setae.

Genus SINELLA Brook, 1882.

Claws normal. Clavate tibiotarsal hair well developed. 4

4. Mucro falciform. Genus DREPANURA Schött, 1896.
Mucro dentate. Genus ENTOMOBRYA Rondani, 1861.
† Dentes spined. Subgenus *Homidia* Börner, 1906 (not Australian).
‡ Dentes not spined. Subgenus ENTOMOBRYA s. str. Börner, 1906.

5. Dentes spined. 6
Dentes not spined. 8

6. Claw with basal wing-like tooth. Genus *Metasinella* Denis, 1923 (not Australian).
Claw normal. 7

7. Dental spines in a single row. Genus *Acanthurella* Börner, 1906 (not Australian).
Dental spines in a multiple series. Genus ACANTHOCYRTUS Handschin., 1925.

8. Dentes scaled. Body scales apically rounded, or if pointed then obtusely so. 10
Dentes not scaled. Scales of body acutely pointed apically, and with comparatively few long striations. 9

9. Mesonotum overlapping head. Apical segment of abdomen with a finger-like process. Antennae longer than half the body. Mucro bidentate with basal spine. Genus *Epimetrura* Schött, 1925. (not Australian).
Mesonotum not overlapping head. Apical abdominal segment without finger. Antennae shorter. Genus SIRA Lubbock, 1869.

10. Antennae III. and IV., or only IV., annulated. 11
Antennae not annulated. 13

11. Mucro falciform. Genus LEPIDOCYRTINUS Börner, 1903.
Mucro dentate. 12

12. Mesonotum very strongly overlapping head, about 4 times as long as metanotum. Genus LEPIDOCYRTOIDES Schött, 1917.
Mesonotum not so strongly overlapping head, only twice as long as metanotum. Gen. MESIRA Börner, 1903; Handschin, 1925, nec. Schtscherbakow, 1898.

13. Claw with basal wing-like tooth. 18
Claw normal, without wing-like teeth. 14

14. Scales hyaline, markings scarcely visible. Antennae IV. without retractile terminal organ. 15
Scales more chitinised, markings distinctly visible. Antennae with retractile organ at apex. 17

15. Tibiotarsal clavate hair absent. Mucro bidentate, with 2 basal spines. Claw sickle-like. Empodial appendage with strong inner angle. Genus *Trichogaster* Handschin, 1931 (not Australian).
Not as above. 16

16. Mucro bidentate with basal spine. Genus LEPIDOCYRTUS Bourlet, 1839.
Mucro falciform. Genus *Drepanocyrtus* Handschin, 1925 (not Australian).

17. Mucro dentate. Genus LEPIDOSIRA Schött, 1896
Mucro falciform. Genus PSEUDOSIRA Schött, 1896. = *Mesira* Schtscherbakow, 1898.

18. Empodial appendage also with wing-like tooth. Genus *Lepidosinella* Handschin, 1919 (not Australian).
Claw only with wing-like tooth. 19

19. Basal wing-like tooth of claw single, scale-like. Genus *Sirodes* Schäffer, 1897. (not Australian).

With a pair of well-developed basal wing-like teeth to claw.
Genus PSEUDOSINELLA Schäffer, 1897.

(a') Antennae 5 to 6 segmented, I. or II. subdivided (seldom 4-segmented, if so then IV. as long as body). Mucro bidentate with basal spine.
Tribe ORCHESELLINI, Börner, 1906.

1. Without scales. Antennae 6-segmented. Abd. IV. twice as long as III.
Genus *Orchesella* Templeton, 1835 (not Australian).

With scales. 2

2. Antennae 4-segmented, IV. thickly annulated and longer than body. Abd. IV. only a little longer than III. Genus *Typhlopodura* Absolon, 1900 (not Australian).

Antennae 5 to 6-segmented. Abd. IV. 3 to 8 times as long as III. 3

3. Apex of abdomen with a long articulate process.
Genus *Heteromuricus* Imms, 1912 (not Australian).

Without this process. 4

4. Antennae 5-segmented, IV. and V. or only IV. annulated. 5
Antennae 6-segmented, V. and VI. annulated Dentes spined.
Genus *Dicranocentrus* Schött, 1896 (not Australian).

5. Species without dental spines. 6
Species with spined dentes. Genus *Alloscopus* Börner, 1906 (not Australian).

6. Abd. IV. not more than 5 times as long as III.
Genus *Heteromurus* Wankle, 1861 (not Australian).

† Antennae V. annulated, Ocelli 2 or nil.
Subgenus *Heteromurus* s. str. Handschin, 1929.

‡ Antennae IV. and V. annulated. Ocelli absent.
Subgenus *Verhoeffiella* Absolon, 1900.

Abdomen IV. about 8 times as long as III. Antennae IV. not annulated. Thorax II. overhanging head. Genus *Strongylonotus* MacGillivray, 1894 (not Australian).

II. Dentes not annulated, not or only very slightly tapered apically.

(a) Dentes without fringed scales or setae dorsally, similarly haired dorsally or dorsolaterally. Dental spines present or absent. Empodial appendage with 4-winged edge. Mucro plump, separated or not from dens. With or without scales. In all known forms with ocelli and free living. Subfamily PARONELLINAE Börner, 1906.

1. Scales species. 4
Without scales. 2

2. Dentes distally, near base of mucrones with a scale-like appendage Antennae twice as long as body. Mucro bidentate. Genus SALINA MacGillivray, 1894. = *Cremastocephalus* Schött, 1896.

Dentes without this appendage. 3

3. Mucro not distinctly separated from dentes. Antennae more than twice as long as body, and beneath with long, stiff setae, which are almost as long as segment. Mucro bidentate. Genus *Chaetoceras* Handschin, 1926 (not Australian).

Mucro separated, from dentes, with 2 teeth. Antennae not longer than body and without above setae. Body strongly convex longitudinally.
Genus PERICRYPTA (Ritter, 1910) Schött, 1917.

4. Body strongly humped in thoracic region. 5
Body normal. 6

5. Hump most pronounced on mesothorax. Antennae 5-segmented. Mucro with 5 teeth.
Genus *Idiomerus* Imms, 1912 (not Australian).

Hump most pronounced on metathorax. Abd. IV. very long and basally bent almost at right angles with III. Dentes spined or not.
Genus *Campylothorax* Schött, 1893 (not Australian).

6. Antennae half as long as body, I. and II. densely clothed with long black setae. Dentes spined. Mucro with 5 teeth.
Genus *Dicranocentroides* Imms, 1912 (not Australian).

Antennae normal. 7

7. Mucro with 2 to 4 teeth, small. Dentes spined. 8
Mucro with 5 to 7 teeth. 10

8. Spines of dentes simple. 9
Spines of dentes compound or serrated. Mucro indistinctly separated from the dens, with 3 teeth. Largest median tooth of dens upturned.
Genus *Bromacanthus* Schött, 1925 (not Australian).

9. Mucro with only two teeth, often reduced to a stump.
Genus PSEUDOPARONELLA Handschin, 1925.

Mucro with 3 to 4 teeth, always well developed.
Genus *Paronella* (Schött, 1893) Handschin, 1925 (not Australian).

10. Dentes with small blister or scale-like appendage apically.
Genus *Microphysa* Handschin, 1925 (not Australian).

Dentes without this appendage. Genus *Aphysa* Handschin, 1925 (not Australian).

(a′) Dentes dorsally with ciliated or fringed scales or spines. Empodial appendage with 3-winged edge, or more or less reduced. Blind and scaled species.
Subfamily CYPHODERINAE Börner, 1906.

(b) With an inner dorsal row of ciliated spines on dentes. Mucro at right angles to dens. Free living forms in caves.
Tribe TROGLOPEDETINI Börner, 1906.
Single genus *Troglopedetes* Absolon, 1907 (not Australian).

(b′) With a double row of fringed scales on dentes. Termitophilous or myrmecophilous forms. Tribe CYPHODERINI Börner, 1913.

1. Mandibles with normal molar plate. 2
Mandibles stylet-like, without molar plate. Body cylindrical. Mucrones claw-like. Clothing different in male and female.
Genus *Calobatella* Börner, 1913 (not Australian).

2. Claw lobe-like with basal spine. Empodial appendage normal or rudimentary. Genus *Cyphoderodes* Silvestri, 1911 (not Australian).

Claw of normal structure. Empodial appendage with wing-like tooth. 3

3. Head of normal prognathus form. Mandibles with well-developed molar plate. Dentes mostly with 5 inner and 6 outer dorsal scales.
Genus CYPHODERUS Nicolet, 1841.

Head hypognathus. Mandibles small with ornamented molar plate. Dentes only with 2 to 3 inner and 5 outer dorsal scales. Mucrones small. Antennae II. to V. with small curved sensory hairs.
Genus *Pseudocyphoderus* Imms, 1912 (not Australian).

Selected Bibliography.

Owing to the necessity for economy of space, this bibliography only contains the papers actually cited in the text, together with a few of the more important and recent works. The latter will be found to contain very full lists of the literature on the Collembola.

The numbers quoted in Part I., Poduroidea, of this paper, published in these Proceedings, 1933, will necessarily be altered as follows:—29 (1), 35 (2), 38 (3), 44 (4), 68 (5), 82 (6), 84 (7), 158 (21), 168 (23), 177 (24), 198 (26), 226 (28), 238 (31), 241 (32), 265 (33).

(1) Bell, H. D. 1919—Insect Life on Sewage Filters. *London.*

(2) Börner, C. 1902—Das Genus Tullbergia Lubbk. *Zool. Anz.*, **vol. xxvi.** 123.

(3) „ „ 1906—Das System der Collembolen, nebst Beschreibungen neuer Collembolen des Hamburger Naturhistorischen Museums. *Mit., Nat. Hist. Mus., Hamburg.* 147.

(4) „ „ 1913—Die Familien der Collembolen. *Zool. Anz.*, **vol. xli.** 315

(5) Carpenter, G. H. 1905—*Proc. Assoc. Econ. Biol.*, **vol. i.** 14.

(6) Collinge, W. E. 1906—Rept. on Injurious Insects in the Midland Counties During 1905. *Birmingham.*

(7) „ „ „ 1912—Springtails. *Manual of Injurious Insects.* 22-24.

(8) Denis, J. R. 1931—Collemboles de Costa Rica avec une Contribution au Species de l'Order. *Boll. Lab. Zool. Portici.*, **vol. xxv.** 69-170.

(9) „ „ „ 1933—Contributo alla conoscenza del "Microgenton di Costa Rica." *Boll. Lab. Zool. Portici.*, **vol. xxvii.** 222-322.

(10) Folsom, J. W. 1913—North American Springtails of the Subfam. Tomocerinae. *Proc. U.S. Nat. Mus.*, **vol. xliv.** 451.

(11) „ „ „ 1916—North American Collembolous Insects of the Subfamilies Achorutinae, Neanurinae and Podurinae. *Proc. U.S. Nat. Mus.*, **vol. l.** 477.

(12) „ „ „ 1917—North American Collembolous Insects of the Subfamily Onychiurinae. *Proc. U.S. Nat. Mus.* 53

(13) „ „ „ 1933—Economic Importance of Collembola. *J. Econ. Entom.*, **vol. xxvi.** 934-939.

(14) Guthrie, J. E. 1903—The Collembola of Minnesota. *Geol. Nat. Survey Minnesota.* 4.

(15) Handschin, E. 1920—Collembola aus Java. *Rev. Suisse Zool.*, **vol. xxviii.** 8, 135.

(16) „ „ 1920—Die Onychiurinen der Schweiz. *Verh. Nat. Ges., Basel*, **vol. xxxii.** 1.

(17) HANDSCHIN, E. 1925—Beitraäge zur Collembolenfauna der Sundainseln. *Treubia.* 228.

(18) " " 1929—Urinsekten oder Apterygota. *Die Tierwelt Deutschlands.* 16.

(19) IMMS, A. D. 1912—On some Collembola from India, Burma, and Ceylon. *Proc. Zool. Soc. London.* 80.

(20) " " " 1906—Anurida. *L'pool Marine Biol. Mem.* 13.

(21) LINNANIEMI, W. M. 1907-12—Die Apterygotenfauna Finlands. *Acta. Soc. Sc. Fennicae*, **vol. xl.**

(22) LUBBOCK, J. SIR 1873—Monograph of the Collembola and Thysanura. *Ray Soc. London.*

(23) " " " 1899—On some Australasian Collembola. *Jour. Linn. Soc. London.* (Zool.), **vol. xxvii.** 334.

(24) MATSUMATA, S. 1930—Studies on Onychiurus Injurious to Wheat Shoots. *Rev. Applied Entom. A.* Oct.

(25) MILLS, H. B. 1934—A Monograph of the Collembola of Iowa. *Collegiate Press, Ames, Iowa.* 1.

(26) RAINBOW, J. W. 1907—Two New Species of Australian Collembola. *Rec. Aust. Mus.*, **vol. iv.** 313-4.

(27) SCHÖTT, H. 1901—Apterygoten von Neu-Guinea und den Sundainseln. *Termeszetrajzi Fuzetek.*, **vol. xxiv.**

(28) " " 1917—Collembola in Results of Dr. E. Mjöberg's Swedish Exped. to Australia in 1908-13. *Ark. f. Zool.*, **vol. ii.**

(29) " " 1925—Collembola from Mt. Murud and Mt. Dulit, in Northern Sarawak. *Sarawak Museum Journal*, **vol. iii.**, pt. 1, No 8. 107-127.

(30) " " 1927—Kamerunische Collembola. Linkoping.

(31) STACH, J. 1929—Die Gattung Brachystomella Agr. (Collembola) und ihre Arten. *Bull. Acad. Pol. Sc. Lettres.* (1928), p. 355.

(32) THEOBALD, F. V. 1910—Springtails (Collembola). Their Economic Importance with Notes on some Unrecorded Instances of Damage. *Rept. les Congres Internat. d' Entom. (Bruxelles)*, 2, 1-18.

(33) WOMERSLEY, H. 1928—A New British Species of Collembola. *Ann. Mag. Nat. Hist.*, ser. 10, 2.

(34) " " 1934—On some Collembola-Arthropleona from South Africa and Southern Rhodesia. Annals South African Mus., **vol. xxv., pt. 3.** pp. 441-475.

SOME AUSTRALIAN ANAPORRHUTINE TREMATODES.

By PROFESSOR T. HARVEY JOHNSTON, University of Adelaide.

[Read September 13, 1934.]

Early in the present year three species of *Probolitrema, P. rotundatum, P. clelandi* and *P. simile*, were described from South Australian elasmobranchs (Johnston, 1934). The last two, from the same host, were stated to be closely related and perhaps synonyms. Since additional material of these species has become available for study, the opportunity was taken to re-examine the late Professor S. J. Johnston's type slides of *Petalodistomum cymatodes* and *P. polycladum,* for which thanks are tendered to Professor Harvey Sutton of the School of Public Health and Tropical Medicine, University of Sydney.

STAPHYLORCHIS CYMATODES (Johnston) Travassos.

This species, originally described as *Petalodistomum cymatodes* by S. J. Johnston (1913, 392), was based on a single specimen collected from the body cavity of a spotted stingray (leopard ray), *Dasyatis kuhlii* M. & H., from Townsville, North Queensland.

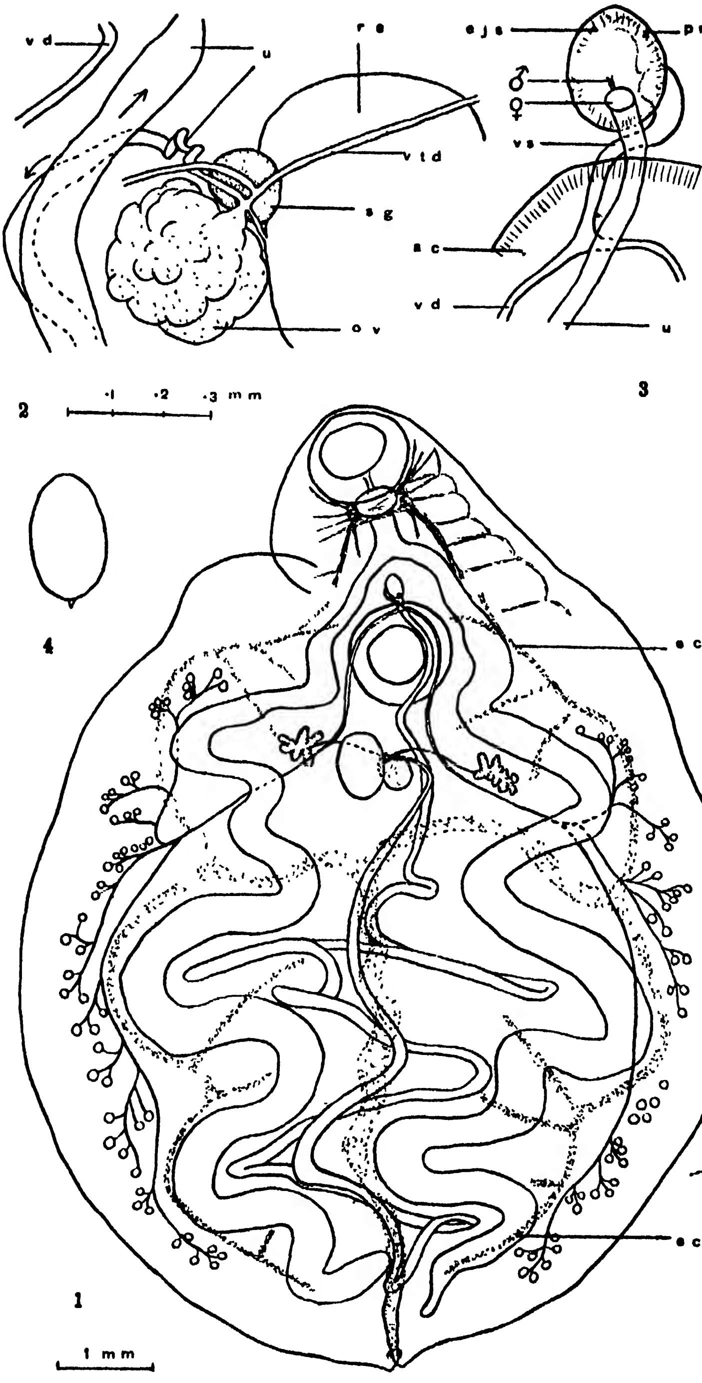
Mainly on account of the characters of the testes and intestine, Travassos (1922, 226) erected the genus *Staphylorchis* for it, giving the following diagnosis:—Anaporrhutinae; body flat, broad; pharynx present; intestinal crura sinuous, without diverticula; vitellaria intracaecal; testes extracaecal, very small and numerous. He regarded it as being nearer to *Anaporrhutum* than to *Petalodistomum*. Fuhrmann (1928, 112) referred to the genus as *Straphylorchis*.

Thanks to the kindness of Professor Harvey Sutton, School of Public Health and Tropical Hygiene, University of Sydney, the type slide was made available for further study. The form and general anatomy are shown in Johnston's figure, but a closer examination of the specimen has permitted an amended and more detailed account, especially of the reproductive and excretory systems.

S. cymatodes is a large trematode, 10·4 mm. long by 1·7 mm. broad, with the suckers approximately equal in diameter (1·1 mm.). The genital pore lies a short distance in front of the acetabulum. The pharynx is somewhat lens-like, 0·50 mm. broad by 0·31 mm. long. There is a rather wide oesophagus. The crura are at first narrow, gradually widening, being broadest in their posterior half. They are thrown into a number of wide undulations and terminate near the end of the worm.

The specimen has the brain and main nerves arising from it well shown. The brain has the usual position above the pharynx and from it are given off, more or less symmetrically, nerves passing forwards along the anterior sucker, several short ones laterally and a long dorsal and ventral from each posterior corner, the ventral being the larger. The latter travels posteriorly in close association with the intestine. It gives off numerous lateral nerves which all become connected with a lateral nerve near the margin of the parasite. The dorsals were not traced backwards.

The main excretory canals were traceable in the specimen. The vesicle is tubular and extends a great deal further forward than the original figure indicates. A little distance behind the ovary this longitudinal canal bifurcates, each branch passing outwardly to meet the corresponding lateral vessel in the vicinity of the mid-length of the worm. The connections shown in the original figure, between the posterior end of each lateral canal and the vesicle, are incorrect. The course



Figs. 1-4.

Staphylorchis cymatodes.—1, Type, dorsal; 2, female complex, ventral; 3, region of genital pore, ventral; 4, egg. a c, acetabulum; e c, excretory canal; e j s, ejaculatory sac; o v, ovary; p r, prostate; r s, receptaculum seminis; s g, shell gland; t, testis; u, uterus; v d, vas deferens; v s, vesicula seminalis; v t d, vitelline duct.

of the tubes arising from the lateral vessels is indicated in fig. 1. From the anterior branch, one is given off to the vitelline region, one to the area just in front of it, and the bifurcate end drains the part between the suckers. The posterior branch is the larger and from it arise two tubes near one another, and a smaller one further back. The main excretory ducts are thus disposed more like those of *Anaporrhutum.*

The type specimen has 47 round testes on one side and 52 on the other. They lie extracrurally extending from just in front of the level of the vitellaria to a point a short distance in front of the end of the crura. They are about 0·1 mm. in diameter. The arrangement of the ducts shows that though the vesicles appear to form a continuous series there are really three groups of them on each side, a small anterior group of 13 to 17, a middle group of about 12 to 15, and a posterior group comprising the remainder. Each vesicle is continuous with a delicate duct and groups of two to four of these efferent tubules join to enter the larger ducts. The anterior vas deferens passes backwards close to the crus (and may lie below a loop of it) to join the middle posterior vas a short distance behind the level of the ovary. The posterior vas is the largest duct and may or may not underlie a lobe of the crus. It travels forwards near the excretory canal, its anterior part lying inwardly from, and approximately parallel to, the middle vas. It meets the combined anterior and middle ducts, and then passes inwards below the intestine and forwards diagonally just inwardly from the corresponding yolk gland. At the level of the ovary it bends forwards, travelling above the acetabulum and inwardly from the crura. The two vasa meet above the anterior margin of the ventral sucker, to form a small vesicula seminalis. This travels forwards near the midline above the metraterm and ejaculatory sac, and enters the latter in its anterior region. The walls of the sac are thickened, probably due to the presence of prostate glands. The structure is about 0·28 mm. long by 0·2 mm. broad. The male aperture is adjacent to the uterine pore, but the exact relationships were not made out. The arrangement appears to be very like that figured by Looss (1902, pl. 23, fig. 32) for *Plesiochorus cymbiformis,* except that the vesicula is quite small.

The ovary is median, a little distance behind the ventral sucker. It measures about 0·32 mm. broad by 0·32 mm. long and has a number of low, broad, rounded projections, the organ appearing rather compact. The short, wide oviduct travels forwards and inwards and, after receiving the tiny duct from the receptaculum, enters the shell gland which lies in front of it in an angle made by the receptaculum and the anterior border of the ovary. The seminal receptacle is rounded, 0·53 mm. long by 0·67 mm. wide, lying slightly to one side of the midline. The shell gland measures 0·15 by 0·18 mm. The fertilizing duct, after traversing it, becomes thrown into a few very short convolutions immediately in front of the ovary and then passes, as the uterus, below the descending limb of that organ. Its course is thus different from that previously described, and is similar to that in other Anaporrhutine trematodes. It now follows a more or less median course until it reaches the region between the ends of the crura. It then becomes thrown into a few wide loops in the post-ovarian part of the body, the loops extending almost from one crus to the other. It eventually passes forwards above the early portion of the duct, then to one side of, and close to, the ovary and forwards above the acetabulum to terminate just in front of it and just behind the cirrus sac. Very few eggs are present in the type, and most of them are very distorted. A typical specimen measured 0·05 by 0·028 mm. and possessed a small terminal projection. The largest egg observed measured 0·065 by 0·040 mm., excluding the "spine." The projection varied considerably in length, being most marked in under-sized eggs. S. J. Johnston gave 0·06 to 0·064 by 0·03 mm. as the dimensions. The yolk glands lie internally to the crura and

very slightly in front of the level of the ovary. Each consists of a branched tube, the branches being short and rounded and clustered at the end of the yolk duct. The two ducts pass almost directly inwards just in front of the ovary, one of them lying ventrally to the anterior region of the receptaculum. They join below the shell gland, and a very short, common duct passes back to unite with the fertilizing duct just after its junction with the canal from the receptaculum and immediately before it enters the shell gland.

Our study of the type indicates that *Staphylorchis* is more closely related to *Anaporrhutum* than to any of the other genera in the subfamily, but differs from it in the extracaecal distribution of the minute spherical testes; the completely intercaecal position of the vitellaria; and the sinuous form of the intestinal crura. In the last of these characters, as well as in the form of the excretory vesicle and of the testes, it differs from *Petalodistomum,* which also has a branching intestine.

In 1930 Nagaty republished Johnston's figures (in part) and gave a generic diagnosis evidently based on Travassos. He also reviewed the Anaporrhutinae, giving a tabulated comparison of the chief anatomical features of the genera assigned to the subfamliy.

Baylis (1927, 426) transferred *Anaporrhutum largum* Luehe, 1906, to *Staphylorchis,* and gave a figure of a specimen from *Stegostoma tigrinum* from Madras. Luehe's material came from the coelome of a Cingalese ray, *Rhinoptera javanica.* Southwell (1913, 101) recorded it as *A. largum* from *Chiloscyllium indicum, Ginglymostoma concolor* and *Aetobatis narinari* from Ceylon, and mentioned that a species of *Anaporrhutum* was taken from *Stegostoma tigrinum* off Orissa. He referred to certain differences between the specimens from these two localities, but thought that they probably belonged to the same species.

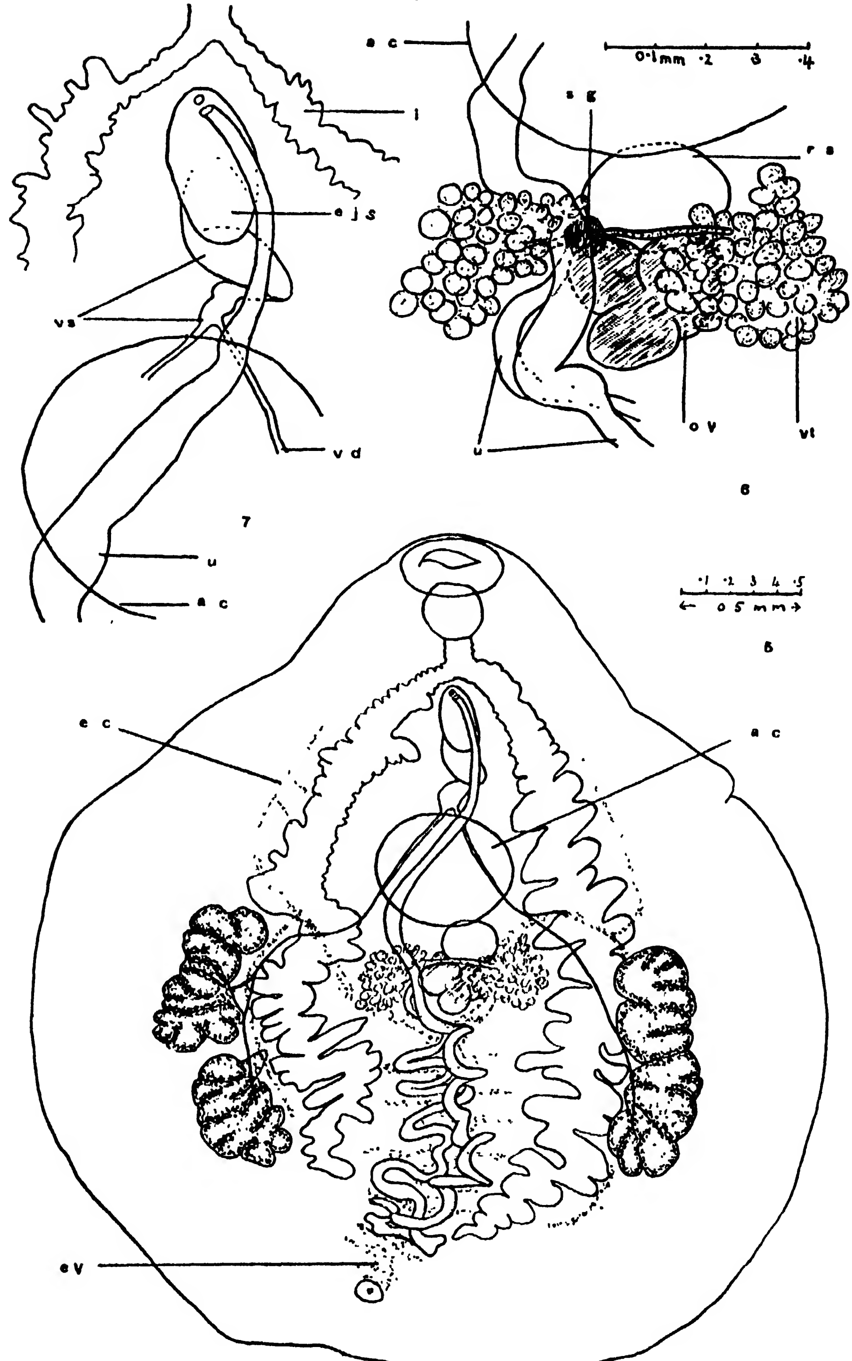
Nagaty (1930, 102) gave a brief account of *S. largus* from *Ginglymostoma concolor* from Ceylon. Some of his specimens showed amphitypy, as he stated that the ovary and metraterm occurred on either the right or the left of the midline. He mentioned that the excretory vesicle was Y-shaped.

Judging from Baylis' account, *S. largus* is more circular in outline; it has larger and fewer testes, and these are much more restricted in distribution; the lateral regions of the body are much more extensive; the intestinal folds are much closer, more numerous and less regular; the uterine folds occupy a much more restricted region, and there is a marked difference in the sizes of the two suckers, the ventral being 2½ times the oral in diameter. The testes, though few in number, were found by Baylis to be unequal on opposite sides, just as Luehe had observed. A similar condition occurs in the type specimen of *S. cymatodes.*

Petalodistomum polycladum S. J. Johnston.

This species was obtained from the body cavity of *Dasyatis kuhlii* M. & H., from North Queensland (S. J. Johnston, 1913, 389-92). Thanks to the kindness of Professor Harvey Sutton, the type slide and a series of sections were made available for further study. Unfortunately the series is somewhat incomplete and disarranged and obviously made from a distorted specimen. These defects have prevented a more satisfactory account of the excretory system being given. The type is small and almost round, 3·76 mm. long by 3·5 mm. broad, narrowing somewhat in the anterior third, but with a broadly rounded posterior region. S. J. Johnston (1913, 390) reported that the length of his specimens varied between 3·3 and 3·7 mm., and the breadth between 3 and 3·5 mm. The type must have been his largest specimen.

The oral sucker has a diameter of 0·44 mm. and the ventral 0·65, the ratio being 1 : 1·47, the original account stating that the oral ranged from 0·375 to 0·424 and the ventral from 0·636 to 0·652 mm., the ratio being 1 : 1·6. The



Figs. 5-7.

Petalodistomum polycladum.—5, Type, ventral, position of male ducts and excretory system added from serial sections; 6, female complex—ventral; 7, region of sex apertures, ventral, composite figure from type and sections. Figs. 6 and 7 drawn to same magnification. a c, acetabulum; e c, excretory canal; e j s, ejaculatory sac; e v, excretory vesicle; i, intestine; o v, ovary; r s, receptaculum seminis; s g, shell gland; u, uterus; v d, vas deferens; v s, vesicula seminalis; v t, vitellarium.

pharynx is 0·25 mm. in diameter and is succeeded by a short oesophagus. The crura which terminate some distance from the posterior end, possess numerous short, irregular sacculations or short, wide branches given off from both the inner and outer surfaces. These irregularities are also present, though small, in the region of the bifurcation also. The intestine is remote from the lateral edges of the worm.

The serial sections do not allow of information additional to that in the original account being given regarding the nervous system. The excretory pore is definitely dorsal, about midway between the posterior limit of the uterus and the end of the parasite. The vesicle extends forwards above the uterus to the hind margin of the ovary, then bifurcating, the limbs extending outwards and forwards above the vitellaria, one limb being adjacent to the outer edge of the seminal receptacle. They then pass below the intestine and, at about the level of the rear edge of the acetabulum, each branches into a shorter anterior and a larger posterior excretory canal lying immediately laterally from the intestine. The posterior canal occupies a position between the latter and the corresponding testis. The point of origin and the course of the ducts entering the lateral canals could not be determined satisfactorily from the material under examination. The main vesicle is not a simple tube but, as Johnston has stated, possesses a number of lateral projections.

The testis of each side lies laterally from the intestine and close beside it. Each extends forwards practically to the mid-length of the worm, and thus lies behind the level of the posterior end of the acetabulum. The posterior fifth of the body is free from them. Each testis forms one or two masses and presents a much lobulated surface, the lobes being short, broad, and closely set. The testicular ducts from the anterior and posterior portions of the gland lie near the inner margin. They join near the middle of the organ to form the vas deferens which travels forwards and inwards below the intestine at about the level of the receptaculum. The vasa pass close to the inner side of the corresponding caecum, one vas lying between the latter and the metraterm. They meet in the midline just above the anterior edge of the acetabulum and form a swollen seminal vesicle which becomes thrown into a few short convolutions lying above the metraterm. The ejaculatory sac is rather small (about 0·3 mm. long by 0·15 mm. broad) and lies below and in front of the anterior end of the vesicula. Its walls are considerably thickened owing to the presence of gland cells. There is a narrow canal leading from the sac downwards to the male pore which is situated immediately in front of the uterine aperture, the two lying just behind the intestinal bifurcation.

The ovary has three rounded lobes, two anterior and one posterior. It measures 0·32 mm. in maximum breadth by 0·28 mm. in length, and is about 0·8 mm. in diameter. It lies on the right of the midline above the right anterior ovarian lobe, and is in close contact with the rounded receptaculum. The latter, which measures 0·29 mm. in breadth and 0·22 mm. in length is situated just to the left of the midline immediately in front of the ovary and partly overlaps it. It lies adjacent to the posterior margin of the acetabulum. Its extremely narrow duct arises posteriorly and travels inwards between the ovary and receptaculum, joining the short oviduct very close to the ovary. The fertilizing duct passes diagonally forwards through the shell gland, then becomes slightly twisted and widened and passes back directly above the descending limb of the uterus. The two limbs keep rather close company and occupy a restricted median region, which extends posteriorly a little beyond the ends of the intestine, but does not reach the crura laterally. The descending limb passes forwards to the right of the ovary, which it may partly underlie, below the shell gland and to the right of the receptaculum. In the type it passes below the yolk duct but above some of

the right vitelline lobes. It then travels above the acetabulum, becoming median. Its terminal portion, the metraterm, was seen, in section, to be thrown into numerous small ridges. This region passes below one of the vasa deferentia, the vesicula and the ejaculatory sac. The female pore lies immediately behind the male aperture, the two being confluent. As S. J. Johnston states, eggs measure 0·052 to 0·063 mm. by 0·023.

The vitellaria occupy a restricted region intercrurally on either side of the ovary. Each has about forty or fifty small rounded projections in the type, though S. J. Johnston mentioned that the gland was composed of 15 to 20 small rounded follicles. Nagaty (1930, 104), in his tabulation of the main characters of the species, states that the vitellarium consists of "small spherical follicles." They are really short tubular processes. Some of those belonging to the left gland underlie part of the ovary and receptaculum. The transverse yolk duct lies ventrally immediately in front of the ovary and underlies part of the receptaculum and the shell gland. A common duct passes upwards in a curved course to lie between the shell gland and the ovary, joining the fertilizing duct in the vicinity of the former.

S. J. Johnston's original generic diagnosis included *Petalodistomum cymatodes* which Travassos removed to a new genus, *Staphylorchis*. Nagaty (1930, 106), in his review of the Anaporrhutine trematode genera, amended slightly Johnston's diagnosis. Our examination of the type does not necessitate any further modification. The generic characters may be stated briefly thus:—Anaporrhutinae; intestinal caeca with numerous sacculations; testes lobed, extracrural; vitellaria composed of numerous tubular lobes, intercrural; excretory vesicle with numerous lateral diverticula.

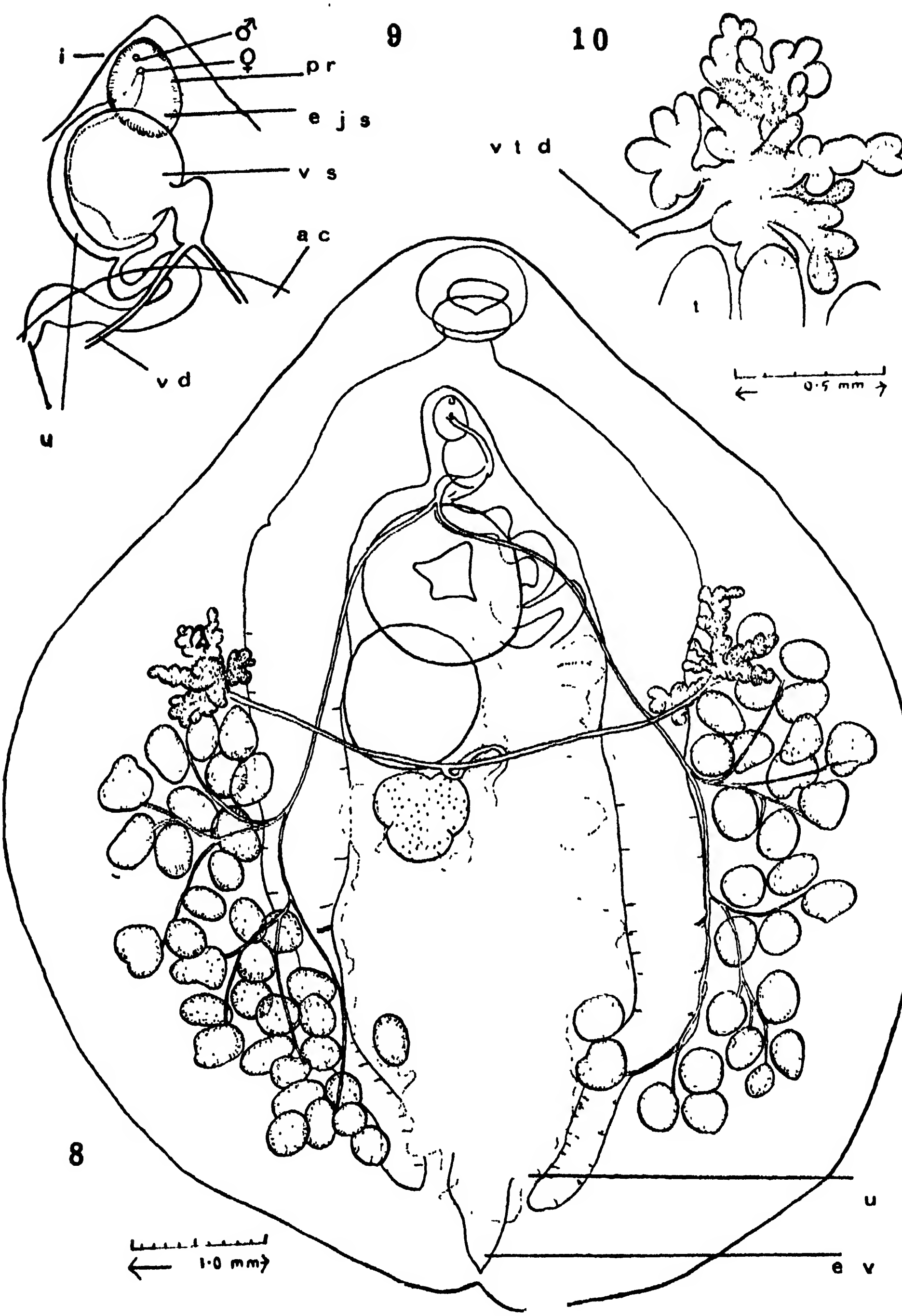
The Genus Nagmia.

Nagaty (1930, 107) characterised a new genus, *Nagmia* (type *N. yorkei*) near *Petalodistomum*, but differing from the latter in its greater size, the shape of the vitelline glands, and the greater number of testicular lobules. Nagaty's account does not include any important characters separating the two genera. Difference in size is not of generic value. Our examination of *P. polycladum* indicates that the vitellaria are of the same type. The deeper lobulation of the testes is probably not a generic character. *Nagmia* is, then, to be regarded as a synonym of *Petalodistomum*. *P. yorkei* (Nagaty) from *Trygon* sp., Ceylon, differs from *P. cymatodes* in size, the relative dimensions of the suckers, the extent of the uterine convolutions, relative sizes of receptaculum and ovary, the position and lobulation of the testes, the larger vitellarian tubes and the size of the eggs.

Probolitrema rotundatum T. H. Johnston.

A mounted flattened specimen from the collection of the late Professor S. J. Johnston and collected from an elasmobranch in Sydney, was made available through the kindness of Professor Briggs. It measures 7·8 mm. long by 6·7 mm. wide. The anterior sucker is 0·8 mm. in breadth by 0·7 in length, and the posterior 1·2 mm. in diameter, the ratio thus being 2 : 3. The body form is almost round. The pharynx measures about 0·5 mm. in width. The oesophagus is short, the wide intestinal crura are thrown into a few slight curves and the inner and outer parts of the posterior region show some small closely-set diverticula. The anterior limits of the excretory vesicle are obscured by the uterine folds. The body is minutely scaly.

There are 28 rounded or elliptical testes on one side and 34 on the other. They vary from 0·28 to 0·5 mm. in length, but most of them measure about 0·4 by 0·3 mm. The majority lie extracrurally, but a few partly underlie the crura and a vesicle is intracrural on each side posteriorly. The vasa efferentia show



Figs. 8-10.

Probolitrema rotundatum (specimen from Sydney).—8, ventral view; 9, region of sex apertures, dorsal; 10, a vitellarium, dorsal; a c, acetabulum; e j s, ejaculatory sac; e v, excretory vesicle; i, intestine; p r, prostate; t, testis; u, uterus; v d, vas deferens; v s, vesicula seminalis; v t d, vitelline duct.

that the vesicles are grouped into an anterior, middle and posterior group, though they are arranged to form a continuous field extending from the vitellarium almost to the end of the crura. Some vesicles overlie part of the yolk glands. Each vas deferens travels forwards below the intestine, then inwardly from it, beside the receptaculum on one side and between the uterus and intestine on the other side. The two vasa curve towards the midline just above the anterior edge of the acetabulum and join to form a swollen vesicula seminalis, at first thin-walled, but becoming bent and enlarged into an almost circular, more centrally placed, one. The latter communicates with the thicker-walled ejaculatory sac lying below and in front of it. This sac measures 0·3 by ·25 mm. The male pore is immediately in front of the uterine aperture and a little distance behind the intestinal bifurcation.

The ovary is slightly trilobed, ·7 mm. wide by ·7 mm. long, and just to the right of the midline. The shell gland lies in the angle formed by the receptaculum and ovary. The uterus occupies most of the intercrural region behind the receptaculum. It eventually passes forwards on the left of the latter and the acetabulum. It bends inwardly below the left vas deferens, becoming thrown into a few short folds, then passing to the left of and below the vesicula, then below the ejaculatory sac to the female pore. The receptaculum has a diameter of a millimetre. Eggs measure 0·067 to 0·07 mm. long by 0·052 to 0·055 mm. broad, each having a low rounded knob at one end.

The vitellaria lie extracrurally at the level of the receptaculum and each consists of about six long lobes, each with numerous small rounded sacculations, the whole organ appearing rather compact. The yolk ducts pass inwards and slightly posteriorly, and after travelling between the ovary and receptaculum, join near the shell gland. The common yolk duct forms a curve posteriorly before joining the oviduct as the latter narrows to enter the shell gland.

The species is tentatively assigned to *P. rotundatum* T. H. Johnston, 1934, described recently from the fiddler, *Trygonorrhina fasciata,* from Kangaroo Island. It agrees in body proportions, sucker ratio and in most anatomical details. It differs in the irregular form of the testes and the presence of more marked sacculations on both inner and outer parts of the posterior region of the intestine in *P. rotundatum.*

Another mounted specimen from S. J. Johnston's collection is 4·5 mm. by 3·7 mm. The anterior sucker has a diameter of 0·6 mm., and the acetabulum, 1·1 mm.; ovary, 0·7 mm. broad by 0·56 mm. long; receptaculum, 0·7 to 0·65; testes, 22 and 25, with the diameter ranging between 0·2 and 0·3 mm. Some posterior testes are intercrural. It belongs to the same species as the other Sydney specimen.

A few typical specimens of *P. rotundatum* were taken recently from the peritoneal cavity of a fiddler caught at Port Willunga, South Australia. The flukes were very mobile and the acetabulum very prominent in life, while the intestine showed through as a brownish-yellow structure.

The sucker ratio of this species is similar to that of *P richiardii* (Lopez, 1888), but the latter is a more elongate parasite with simple crura and with all testes extracrural, while the acetabulum is more anteriorly situated and the vitellaria are relatively more remote in relation to it. The testes are similar in form in the two species, and there are about the same number—24 and 26 being indicated in Looss' figure, but the receptaculum is much smaller and does not reach the acetabulum in the European species.

PROBOLITREMA CLELANDI T. H. Johnston.

Syn. *P. simile* Johnston.

Ofenheim's account (1900) and figure of *P. richiardii,* which Looss (1902) regarded as belonging to a distinct species and named *P. capense,* is not available.

It has the two suckers approximately equal and the acetabulum not especially projecting. The remaining anatomical characters are stated by Looss to be quite similar to those of *P. richiardii* (Lopez). It was collected from *Scyllium* sp. near Capetown.

P. clelandi from *Mustelus antarcticus*, South Australia, has a similar sucker ratio, but if Looss' statement is to be taken literally, then it differs from *P. capense* in the form and distribution of the testes, the more posterior position of the acetabulum, the form of the "head lobe," the size of the receptaculum, and the relative position of the ovary which is in front of the mid-length in *P. capense*, where as in *P. clelandi* it is just behind it and behind the level of the vitellaria.

In the original account of *P. simile* it was noted that the species was closely related to, and perhaps identical with, *P. clelandi* from the same host. The sucker ratio given was given as 14 : 17, but some specimens have the two suckers practically equal in diameter. It seems preferable to regard the two species as synonymous, in spite of the fact that the distribution of the testes is different, no vesicles being intercrural in *P. simile*, whereas some are in *P. clelandi*. The species also occurs in *Mustelus antarcticus* in Tasmanian waters.

Hosts.	Parasites.	Locality.
Dasyatis kuhli M. & H.	*Petalodistomum polycladum* *Staphylorchis cymatodes*	North Queensland " "
Trygonorrhina fasciata M. & H.	*Probolitrema rotundatum*	Kangaroo Is. and Pt. Willunga, South Australia
Mustelus antarcticus Gunth.	*Probolitrema clelandi*	Encounter Bay, South Australia; and Tasmania
Host?	*Probolitrema rotundatum*	Sydney

Summary.

The types of *Petalodistomum polycladum* and *P. cymatodes* are re-described. *Nagmia* is a synonym of *Petalodistomum*. *Probolitrema rotundatum* is recorded from new localities and additional information supplied regarding its anatomy. *P. simile* is regarded as a synonym of *P. clelandi*.

Literature.

Baylis, H. A. 1927—Notes on three little known Trematodes. A. M. N. H. (9), 19, 426-433.

Fuhrmann, O. 1928—Trematoda in Kükenthal's Handb. Zool., 2 (2).

Johnston, S. J. 1913—On some Queensland Trematodes, etc. Q. J. M. S., 59, 361-400.

Johnston, T. H. 1934—New Trematodes from South Australian Elasmobranchs. Austr. Jour. Exp. Biol. Med. Sci., 12, 25-32.

Looss, A. 1902—Ueber neue und bekannte Trematoden aus Seeschildkröten. Zool. Jahrb. Syst., 16, 411-894.

Luehe, M. 1906—Report on the Trematode parasites from the marine fishes of Ceylon. Rep. Ceylon Pearl Oyster Fisheries, 5, 97-108.

Nagaty, H. F. 1930—A new Anaporrhutine Trematode genus and species, etc. Ann. Trop. Med. Parasit., 24, 97-108.

Southwell, T. 1913—Notes from the Bengal Fisheries Laboratory, Indian Museum, I. Rec. Ind. Mus., 9, (11), 6, 79-103.

Travassos, L. 1922—Contribuicoes, etc., xvii., Gorgoderidae brasilieras. Mem. Inst. Osw. Cruz, 15, (1), 220-234.

A REVISION OF THE IPOINAE (HOMOPTERA, EURYMELIDAE).

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[Read September 13, 1934.]

Introduction.

It has been the custom in the past to place all leaf-hoppers with the ocelli situated on the ventral surface of their heads in the Family Bythoscopidae (Superfamily Cicadelloidea). This has been done largely for convenience, since this character by itself is of little phylogenetic significance.

Three groups of leaf-hoppers are found in Australia with this character. These are *Eurymela* Le P. & S. and related genera; *Bythoscopus* Germ. and related genera; and *Idiocerus* Lewis and related genera.

In order to facilitate the classification of the first group it is proposed to give it Family rank, and the following classification is proposed for the Australian leaf-hoppers that have their ocelli ventrally placed:—

Superfamily: JASSOIDEA.

A. Family: BYTHOSCOPIDAE.

1. Subfamily: Bythoscopinae.
   Bythoscopus Germ., *Macropsis* Lewis, *Trocnada* Walk., *Alseis* Kirk., *Epipsychidion* Kirk., *Eurinoscopus* Kirk., *Oncopsis* Burm.
2. Subfamily: Idiocerinae.
   Idiocerus Lewis, *Pedioscopus* Kirk.

B. Family: EURYMELIDAE.

Subfamily: Eurymelinae.
Subfamily: Pogonoscopinae.
Subfamily: Ipoinae.

This paper is primarily concerned with the classification of the Ipoinae; but, in order that students in this country may be able to distinguish representatives of the Bythoscopidae from the Eurymelidae, descriptions are given at the end of the paper of two new species, one belonging to a new genus of the Bythoscopinae and the other to the genus *Idiocerus*.

In addition, a re-description is given of a species described by Jacobi in 1909 under the name of *Ipo procurrens*. This species cannot be placed in any of the known subfamilies of either the Eurymelidae or the Bythoscopidae, although it has certain Eurymeloid characters in addition to others that suggest a possible relationship with the Idiocerinae. A new genus, *Ipocerus*, has been erected to contain it, which for convenience is here grouped with the Ipoinae, until such a time as its position may be better understood.

Eurymelidae.

The Eurymelidae, unlike the Bythoscopidae, are confined to the Australian region, and, as a result of recent work by China (1926)(1) and the present author (1933),(2) have been divided into three groups, which were previously given tribal rank, but are now raised to subfamilies.

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(1) China, W. E., Trans. Ent. Soc., London, 1926 (2), 289.
(2) Evans, J. W., Trans. Roy. Soc., South Austr., 57, 1933.

The Eurymelinae are wedge-shaped insects, blue, black or brown in colour, most species having white or coloured fasciae on their forewings. The subgenital plates of the males are large and broad, and invariably have a style arising from one of their edges. All species, as far as it is known, feed on Eucalyptus trees, and they are all attended by ants.

The Pogonoscopinae are light or dark brown in colour, and frequently have white fasciae on their forewings. They differ very markedly from the other tribes owing to structural modifications brought about by their close association with ants, both the nymphs and adults actually living in ants' nests. Their legs, even in the nymphal stages, are very long, and their eyes small, both characters found in many arthropods that live in the dark. They have no spurs on their hind tibiae, and their labiums reach well past the bases of their hind legs. Like the Eurymelinae, they appear to be confined to Eucalyptus trees.

The Ipoinae comprise a number of genera more or less closely related to each other. They lack the typical Eurymeloid colour pattern, are not confined to eucalypts, are all ant attended, and, with a few exceptions, the males have no styles on the subgenital plates. In addition to those insects comprised in these three tribes, there exist a number of small species, possessing typical Eurymeloid colouration but resembling the Ipoinae in the structure of the male genitalia. Since the material at present available of these species is scanty, their description and classification is postponed.

The multiplicity of genera, paucity of species within the genera, and the wide distribution of many of the species over the continent, suggests that the Eurymelidae are a very ancient race of insects that possibly had their origin in South-Western Australia, since the Pogonoscopinae and *Ipo procurrens* of Jacobi are largely confined to this area, although the Eurymelinae and Ipoinae extend to Eastern Australia, and as far as New Guinea and New Caledonia.

Key to the Genera of the Ipoinae.

1. Hind tibia with only one distinct spur, with or without additional spines. .. 2
   Hind tibia with more than one distinct spur. 9
2. Frons produced, either into a horn, a spatulate process, or as a ledge overhanging the clypeus 3
   Frons not produced, either flat or slightly convex 5
3. Front and middle femora with short blunt spurs on their interior edges; pronotum narrow laterally, the propleuron not produced posteriorly into a toothlike process; the frons produced anteriorly into a narrow ledge that overhangs the clypeus.
   ANACORNUTIPO, gen. nov.
   Type EURYMELA LIGNOSA Walker.

   Front and middle femora spurless; pronotum wide at the sides, the propleuron produced posteriorly into a tooth-like process; frons not produced anteriorly into a narrow ledge. 4
4. Frons produced into a spatulate process. .. .. .. CORNUTIPO, gen. nov.
   Type CORNUTIPO SCALPELLUM, n. sp.

   Frons produced into an upward turning horn; vertex produced into two downturned horns. .. .. CORNUTIPOIDES, gen. nov.
   Type CORNUTIPOIDES TRICORNIS, n. sp.
5. Hind tibia with one spur and no spines; species yellowish or pale reddish-brown in colour. .. .. ANIPO, gen. nov.
   Type EURYMELA PORRIGINOSA Signoret.

   Hind tibia with a few or numerous spines in addition to a single spur. 6
6. Crown of head from above, broad between the eyes, not merely a narrow margin. 7
   Crown of head from above visible only as a narrow margin; tegmina largely hyaline; sub-genital plates with small apical styles. .. .. .. IPOELLA, gen. nov.
   Type IPOELLA FIDELIS, n. sp.

7. Subgenital plates broad (fig. A, figs. 6 and 7) 8
Subgenital plates narrow (fig. A, figs. 8-12) .. .. IPOIDES, gen. nov.
Type IPOIDES HACKERI, n. sp.

8. Small species resembling *Ipo* Kirk. in shape and colouration, the tegmina steeply tectiform .. .. STENIPO, gen. nov.
Type STENIPO SWANI, n. sp.
Species not resembling *Ipo* Kirk. in shape or colouration; tegmina not steeply tectiform. .. .. CITRIPO, gen. nov.
Type CITRIPO FLANDERSI, n. sp.

9. Hind tibia with two spurs and numerous spines. 10
Hind tibia with three spurs and numerous spines. 11

10. Tegmina broad, hyaline or hyaline with black and white areas; appendix continuing broadly round the apex of the tegmen; subgenital plates broad, the parameres reaching to the apices of the plates. .. .. IPO Kirkaldy
Type IPO PELLUCIDA, F
Tegmina narrow; appendix continuing narrowly round the apex of the tegmen; subgenital plates narrow, the parameres not more than half the length of the plates.
KATIPO, gen. nov.
Type EURYMELOIDES RUBRIVENOSUS, Kirk.

11. Hind tibia with one large spur on one of the inner edges of the tibia, and two slightly smaller ones on the other edge; head broader than long; subgenital plates with small styles. .. .. PAURIPO, gen. nov.
Type PAURIPO INSULARIS, n. sp.
Hind tibia with three spurs decreasing in size from the apex of the tibia to the base, all on the same edge of the tibia; head almost as long as broad; subgenital plates without styles. .. .. OPIO, gen. nov.
Type BYTHOSCOPUS MULTISTRIGIA Walker.

The above key is an artificial one and does not group the genera into any natural order. They can, however, be separated into four distinct tribes:—The Ipoini, comprising *Ipo, Stenipo* and *Ipoides;* the Anipoini, comprising *Anipo, Katipo, Citripo* and *Ipoella;* the Cornutipoini, comprising *Cornutipo, Cornutipoides* and *Anacornutipo;* and finally the Opioni, containing the isolated genus *Opio.*

The colour patterns of the majority of the species comprised in the Eurymelidae are extremely variable, and descriptions largely based on a detailed account of the colouration of a few individuals are of little value. The characters afforded by the male genitalia are valuable for both specific and generic determination, and accordingly figures are given for every species described in this paper.

Ipoini. IPO Kirkaldy.

H.S.P.A. Exp. Sta. Rec. Bull. 1 (9); 464, 1906.

Wedge-shaped insects, the tegmina steeply tectiform apically; head much broader than long, slightly rounded, maxillary plates broad, antennal pits shallow, eyes prominent, the labium just reaching to the base of the hind legs, the crown of the head from above only visible laterally against the eyes; tegmina broad. the appendix narrow, continuing round the apex of the tegmen to the costal margin; hind tibia with two spurs and numerous strong spines; male genitalia with large flat-subgenital plates and long parameres, the aedeagus with a strong armature of spines at the apex and without an anterior ventral process.

Species comprised in this genus are apparently confined to the tropical regions of the continent.

IPO PELLUCIDA F. (Fig. A, fig. 15.) (Genotype.)

Cicada pellucida Fabricius. Entom. Syst. 4; 41, 60, 1794. *Ipo ambita* Kirkaldy, H.S.P.A. Exp. Sta. Rec. Bull. 1 (9); 464, 1906. *Ipo aegrota* Kirkaldy, H.S.P.A. Exp. Sta. Rec. Bull. 1 (9); 464, 1906.

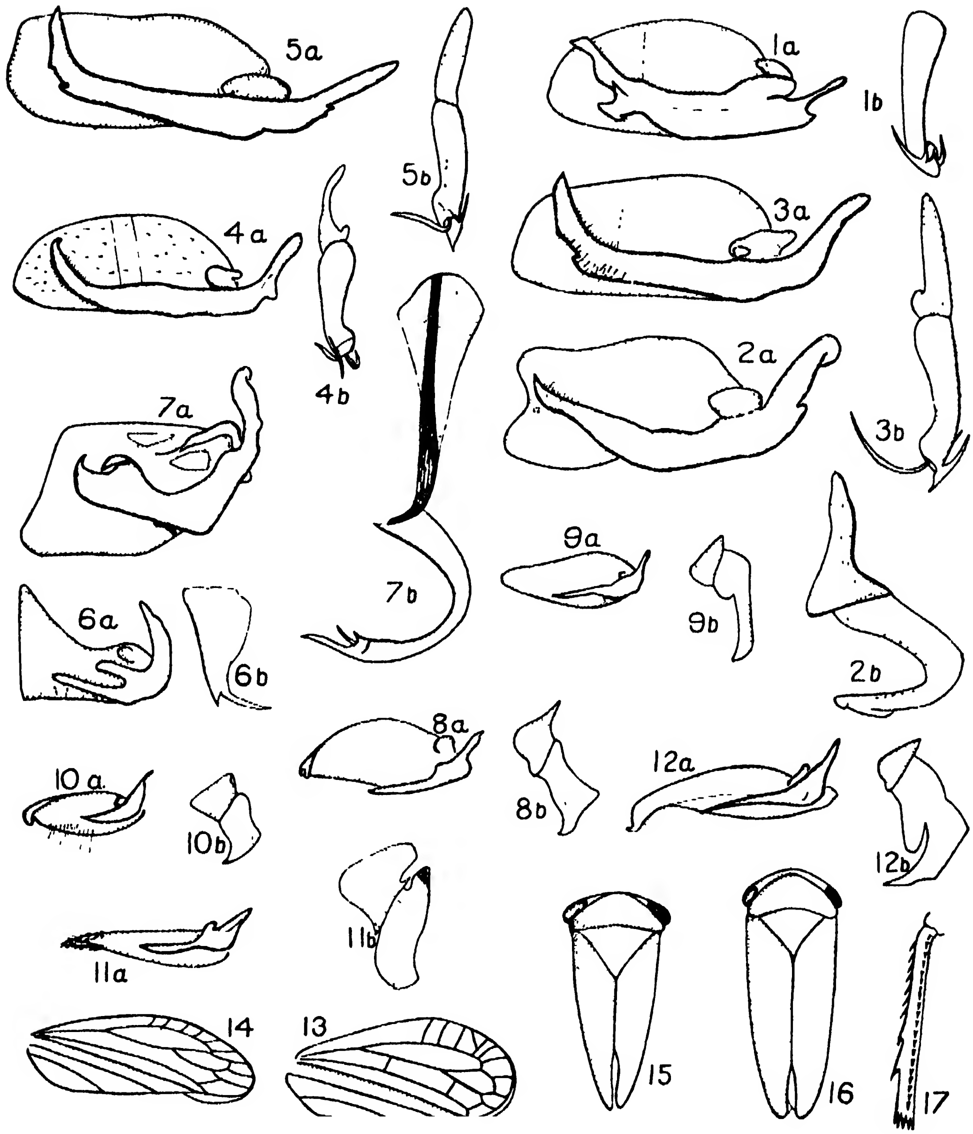

Fig. A.

Figure 1a .. *Ipo pellucida,* subgenital plate and paramere.
" 1b .. " " aedeagus.
2a .. *Ipo conferta,* subgenital plate and paramere.
2b .. " " aedeagus.
3a .. *Ipo honiala,* subgenital plate and paramere.
3b .. " " aedeagus.
4a .. *Ipo hilli,* subgenital plate and paramere.
4b .. " " aedeagus.
5a .. *Ipo sordida,* subgenital plate and paramere.
5b .. " " aedeagus.
6a .. *Stenipo swani,* subgenital plate and paramere.
6b .. " " aedeagus.

(Continued on opposite page)

Description.—Length, ♂, 6-7 mm.; ♀, 8-9 mm. (from the apex of the head to the tip of the folded tegmina). Head, width between the eyes 3-4 mm., chestnut brown suffused to a varying extent with dark brown. Pronotum, pale or dark brown, with or without a median longitudinal white stripe. Scutellum, smooth, pale or deep chestnut brown. Tegmen, entirely hyaline or transparent, or hyaline or transparent but for a broad anterior hyaline white fascia; anterior costal and claval area punctate; veins dark brown or black with white bars. The tegmen may be mottled with dark brown to a varying extent. Thorax, ventrally pale brown. Legs, femora pale brown, tibiae and tarsi dark brown or black, but for the first tarsal segment of the hind legs, which is white. Abdomen, ventral surface, pale brown. Male genitalia, as in fig. A, figs. 1a and 1b. Parameres bifurcate and extending beyond the apices of the subgenital plates. Aedeagus straight, bearing a strong armature of spines at the apex.

Distribution.[3]—Queensland and Northern Australia.

Ipo conferta Kirkaldy.

Ipo conferta Kirk., H.S.P.A. Exp. Sta. Rec. Bull. 1 (9); 465; 1906. *Ipo pompais* Kirk., H.S.P.A. Exp. Sta. Rec. Bull. 3; 35, 1907.

Description.—Length, 5-7·5 mm. Head, width, 3 mm., punctate; pale yellowish-brown, mottled with dark brown or black, maxillary plates and lorae pale, eyes reddish-brown, not as prominent as in other species in this genus. Pronotum, narrow, punctate, ochreous mottled with dark brown or black. Scutellum, ochreous brown or black with a few pale yellow markings. Tegmen, pale yellowish-hyaline, sparsely mottled with dark brown or black; veins, white or black; an indistinct white hyaline anterior fascia, widest against the costal margin of the tegmen, or tegmen almost entirely suffused with black, except for yellow mottlings on the clavus and an anterior irregular opaque white fascia, not transverse, and a hyaline area against the distal costal margin, which is mottled with black; tegmen, narrow apically. Thorax, ventral surface, pale yellowish-brown. Legs, coxae and proximal two-thirds of the femora pale brown, the rest marked with a pattern of black and brown. Abdomen, ventral surface, pale yellowish-brown. Male genitalia, as in fig. A, figs. 2a and 2b. The distal halves of the ventral edges of the subgenital plates are thickened, the parameres simple, not bifurcate, and the aedeagus curved, not straight

Distribution.—Queensland.

[3] Distribution records refer to specimens actually examined, and do not necessarily indicate the limits of any species.

Fig. A (continued).

Figure 7a .. *Stenipo bifurcata*, subgenital plate and paramere.
„ 7b .. „ „ aedeagus.
„ 8a .. *Ipoides hackeri*, subgenital plate and paramere
„ 8b .. „ „ aedeagus.
„ 9a .. *Ipoides leai*, subgenital plate and paramere.
„ 9b .. „ „ aedeagus.
10a .. *Ipoides translucens*, subgenital plate and paramere.
10b .. „ „ aedeagus.
11a .. *Ipoides ooldeae*, subgenital plate and paramere.
11b .. „ „ aedeagus.
12a .. *Ipoides casurinae*, subgenital plate and paramere.
12b .. „ „ aedeagus.
13 .. *Ipo hilli*, tegmen.
14 .. *Ipoides casurinae*, tegmen.
15 .. *Ipo pellucida*.
16 .. *Ipoides hackeri*.
17 .. *Ipo hilli*, hind tibia.

IPO HONIALA Kirkaldy.

Ipo honiala Kirk., H.S.P.A. Exp. Sta. Rec. Bull. 1 (9); 465, 1906.

Description.—Length, 5-6 mm. Head, width, 3 mm.; crown and vertex pale yellowish-brown suffused with dark brown, the rest of the head pale yellowish or reddish-brown. Pronotum, punctate, grey, mottled with dark brown or black. Scutellum, smooth, black or dark brown, the posterior angle yellow. Tegmen, dark brown or black, an indistinct anterior transverse white or hyaline fascia, the apical third of the tegmen hyaline, and there may be other small hyaline areas scattered over the tegmen; veins brown or black. Thorax, ventral surface dark brown or black. Legs, brown or black. Abdomen, ventral surface, pale yellowish-brown. Male genitalia, as in fig. A, figs. 3a and 3b. The aedeagus straight, one of the apical spines very long and curved.

Distribution.—Queensland.

Ipo hilli, n. sp.

Description.—Length, ♂, 5 mm., ♀, 7 mm. Head, width, 3 mm., light or dark brown mottled with buff; maxillary plates and lorae largely pale brown, the rest of the head mostly dark brown. The whole surface of the head is covered with short hairs. Pronotum, grey mottled with dark brown, and with a broad median longitudinal grey stripe, also hairy. Scutellum, light or dark brown, the posterior margin yellow. Tegmen, anterior claval and costal areas punctate; the anterior two-thirds of the tegmen deep chocolate brown with brown veins, the posterior third transparent with white veins. There is an anterior transverse fascia divided into two areas, one in the costal and one in the claval area, the latter lying along the margin of the scutellum. There are a few small round and narrow longitudinal hyaline areas on the dark part of the tegmen (fig. A, fig. 13). Thorax and abdomen, ventral surface, pale brown. Legs, proximal halves of the femora pale brown, distal halves dark brown; tibiae dark brown with white oval spots, and one or more of the edges of the hind tibiae may be white (fig. A, fig. 17). Male genitalia, as in fig. A, figs. 4a and 4b.

Distribution.—Northern Australia.

Type ♂, from Darwin (coll. G. F. Hill), paratype ♀, both specimens in the collection of the South Australian Museum.

Ipo sordida, n. sp.

Description.—Length, 5 mm. Head, width 2·5 mm.; pale chestnut brown and very dark brown or black, the areas covered by the two colours varying in extent. The head is covered with fine short hairs. Pronotum, grey, densely mottled with dull brown. Scutellum, chestnut brown or very dark brown. Tegmen, largely hyaline, the anterior costal and claval areas punctate; an indistinct broad anterior transverse whitish fascia, veins brown. The whole tegmen is mottled with dull brown, especially in the neighbourhood of the veins, which are faintly and irregularly barred with white. Thorax, ventral surface dark brown. Legs, femora very dark brown with pale areas; tibiae, pale brown. Abdomen, ventral surface, pale brown. Male genitalia as in fig. A, figs. 5a and 5b. Similar in shape to those of *I. honiala,* the recurved spine at the apex of the aedeagus being smaller in this species.

Distribution.—Thursday Island, Queensland.

Type, ♂, from Thursday Island (coll. A. M. Lea); paratypes, 1 ♂ and 1 ♀; all three specimens in the collection of the South Australian Museum.

IPO TORPENS Jacobi.

Ipo torpens Jacobi, Faun. Südwest-Austral., Ergeb. d. Hamburg S. Austral. Forschungsreise 1905, Michaelsen u. Hartmeyer, ii., 20; 341, 1909.

This species, from Mongers Lake, near Subiaco, Western Australia, is unknown to me. Although impossible to place in any genus from the description alone, it is probable that it belongs either to the genus *Ipoides* or *Stenipo,* rather than to *Ipo,* since the length is given by Jacobi as 4·5 mm., also no representatives of the genus *Ipo* have been recorded from Western Australia.

Stenipo, gen. nov.

This genus is very closely related to *Ipo* Kirk., the species comprised in it being smaller, and differing from those in the previous genus in the following characters:—The vertex of the head is broadly visible from above and is as wide in the middle as against the eyes, the tegmina are narrow and the hind tibiae have only one spur in addition to numerous spines.

Stenipo swani, n. sp. (Genotype.)

Description.—Length, 4 mm. Head, width, 2 mm., yellowish-grey suffused with dark brown, in some specimens the frons is pinkish. Pronotum, greyish sparsely mottled with dark brown. There is a broad grey longitudinal median stripe and two brown oval areas lying against the anterior margin. Scutellum, greyish mottled with pale and dark brown. Tegmen, hyaline, the anterior costal and claval areas punctate; there may be a narrow anterior and a broad posterior transverse white fascia, or the tegmen may be almost entirely yellowish-hyaline or opaque; veins black with white bars. Thorax, ventral surface, very dark brown. Legs, pale brown. Abdomen, ventral surface, very pale brown. Male genitalia, as in fig. A, figs. 6a and 6b. Subgenital plates more or less triangular in shape; parameres deeply bifurcate; aedeagus boot-shaped. Host plant, Melaleuca sp.

Distribution.—Rottnest Island, Western Australia.

Type ♂, from Rottnest Island (coll. D. C. Swan, 1/31), in the collection of the C.S.I.R. Division of Entomology at Canberra. Described from a long series of males and females.

Stenipo bifurcata, n. sp.

Description.—Length, 5 mm. Head, 2 mm. wide; the anterior half pale yellowish-brown, the posterior brown, densely mottled with very dark brown and black. Pronotum, greyish, mottled with dark brown; an indistinct broad grey median longitudinal stripe, and two pale brown oval areas lying against the anterior margin. Scutellum, dark brown and grey, the anterior corners chestnut brown. Tegmen, proximal half whitish-opaque, the distal half yellowish-hyaline; anterior costal and claval areas punctate; veins brown with white bars. Thorax, ventral surface dark brown. Legs, pale brown. Abdomen, ventral surface, pale brown. Male genitalia, as in fig. A, figs. 7a and 7b. Subgenital plates wide; aedeagus strongly curved.

Distribution.—South Australia.

Type ♂, paratype ♀, both specimens from Corney Point, South Australia, and both in the collection of the South Australian Museum.

Ipoides, gen. nov.

This genus is closely related to *Stenipo.* The crown is visible dorsally as a broad border, slightly wider against the eyes than in the middle. Tegmina narrow, the appendix big. Hind tibia with one spur and a few small spines. Male genitalia with narrow subgenital plates, short parameres, and the aedeagus without apical spines.

Ipoides hackeri, n. sp. (Genotype.) (Fig. A, fig. 1b.)

Description.—Length, 4 mm. Head, width, 2 m.m,, marked with an irregular pattern of yellow and dark brown, the maxillary plates usually pale, the vertex dark brown and the posterior margin of the crown dull greyish-yellow. Pronotum and scutellum, dull grey mottled with dark brown. Tegmen, transparent, veins pale brown with white bars; some specimens have a trace of a narrow anterior fascia; appendix not continuing round the apex of the tegmen. Thorax, ventral surface dark brown. Legs, pale yellowish-brown. Abdomen, ventral surface pale brown. Male genitalia as in fig. A, figs. 8a and 8b. Subgenital plates recurved at apices, parameres short, aedeagus simple, with no spines or processes.

Distribution.—Queensland.

Type, ♂, from Brisbane (coll. H. Hacker), in the collection of the South Australian Museum. Described from a long series of both sexes.

Ipoides leai, n. sp.

Description.—Length, 4 mm. Head, width, 1·5 mm., ochreous marked with an irregular pattern of dark brown and black. Pronotum, greyish and ochreous mottled with dark brown. Scutellum, dark brown or black with an imperfectly rounded pale area. Tegmen, yellowish-hyaline; an irregular whitish anterior fascia stretching diagonally across the tegmen from near the centre of the costal margin to the apex of the scutellum; veins dark brown barred with white; appendix not continuing round the apex of the tegmen. Thorax, ventral surface dark brown. Legs marked with a variable pattern of light and dark brown. Abdomen, ventral surface, pale brown. Male genitalia, as in fig. A, figs. 9a and 9b. Aedeagus with a very slight anterior ventral process.

Distribution.—New Caledonia.

Type, ♂ from Noumea (coll. A. M. Lea), paratypes 2 ♂'s and 1 ♀; type and paratypes in the collection of the South Australian Museum.

Ipoides translucens, n. sp.

Description.—Length, 4 mm. Head, width 1·7 mm., greyish-buff but for the maxillary plates and lorae which are evenly mottled with dark brown and yellow. Pronotum and scutellum, grey mottled with dark brown. Tegmen, transparent, with two brown spots against the hind margin of the clavus; veins pale brown with white bars; appendix continuing narrowly round the apex of the tegmen. Thorax, ventral surface black. Legs, proximal two-thirds of femora black, distal two-thirds yellowish; tibiae yellowish, the apices of the hind tibiae black. Abdomen ventral surface pale brown. Male genitalia, as in fig. A, figs. 10a and 10 b. Subgenital plates recurved at apices; aedeagus simple.

Distribution.—Queensland.

Type, ♂ from Townsville (coll. F. P. Dodd), paratype ♀, both specimens in the collection of the South Australian Museum.

Ipoides ooldeae, n. sp.

Description.—Length, 5 mm. Head, width, 2·2 mm.; crown from above wider against the eyes than in the centre; head pale yellowish-brown with a few scattered brown spots; eyes and ocelli black, frons distinctly convex (more so than in other species in this genus). Pronotum and scutellum, either entirely greyish-yellow or greyish-yellow mottled with brown or dark brown. Tegmen, transparent; veins brown with white bars; appendix continued very narrowly round the apex of the tegmen. Thorax, ventral surface pale yellowish-brown. Legs, pale yellowish-brown streaked with dark brown. Abdomen, ventral sur-

face, pale yellowish-brown. Male genitalia, as in fig. A, figs. 11a and 11b. Subgenital plates very narrow apically, aedeagus with a posterior dorsal thickening.

Distribution.—Ooldea, South Australia.

Type, ♂ from Ooldea (coll. A. M. Lea), paratypes 1 ♂, 4 ♀'s; type and paratypes in the collection of the South Australian Museum.

Ipoides casurinae, n. sp.

Description.—Length, 5 mm. Head, width, 2 mm., pale yellow mottled with a distinct though variable pattern of light and dark brown, the maxillary plates and lorae invariably pale yellow. Crown from above wider against the eyes than in the centre. Pronotum and scutellum, yellowish-grey mottled with dark brown. There is an indistinct median pale longitudinal stripe on the pronotum. Tegmen (fig. A, fig. 14), hyaline, or with a narrow curved anterior white fascia, which may be only partially developed; veins dark brown with white bars; appendix continuing narrowly round the apex of the tegmen. Thorax, ventral surface dark brown. Legs, pale brown. Abdomen, ventral surface pale brown. Male genitalia as in fig. A, figs. 12a and 12b. The subgenital plates are narrow and the aedeagus has an anterior ventral process, but the genitalia resemble those of the genotype in the apical curvature of the subgenital plates, and in the boot-shaped aedeagus. Host plant, *Casuarina,* spp.

Distribution.—Queensland, New South Wales and Western Australia.

Type, ♂ from Canberra, F. C. T. (coll. J. W. E.), in the collection of the C.S.I.R. Division of Entomology at Canberra, described from a long series of males and females.

Note.—The above species so closely resembles the other species comprised in the genus *Ipoides,* that it is included in this genus, in spite of the fact that the male genitalia do not resemble very closely those of the genotype.

Anipoini. **Ipoella**, gen. nov.

This genus differs from the preceding ones in the following characters:—The labium only reaches to between the middle pair of legs; the head is only visible from above as a very narrow edge in the centre, though slightly wider against the eyes; the anterior margin of the pronotum is at a much lower level than the posterior margin; the tegmina have numerous costal cells; the hind tibiae have a few small spines in addition to one large spur; the subgenital plates in the male are broader, and the aedeagus is differently shaped.

Ipoella fidelis, n. sp. (Genotype.)

Description.—Length, 6 mm. Head, width, 2·5 mm., greyish-yellow with a dark brown T-shaped area, stretching from the base of the clypeus to a little above the dorsal margin of the frons, and extending laterally to the eyes. Pronotum, grey, mottled with dark brown. Scutellum, yellowish-brown. Tegmen, hyaline, irregularly mottled with dull brown; veins brown with white bars. Thorax, ventral surface black. Legs, pale brown streaked with dark brown. Abdomen, ventral surface pale brown. Male genitalia, as in fig. B, figs. 1a and 1b. Subgenital plates broad with a small spine attached to the apical finger-like process; parameres short and broad.

Distribution.—Bunya Mountains, Queensland.

Type, ♂ from the Bunya Mountains (coll. H. Hacker); paratypes 1 ♂ and 1 ♀. Type and paratypes in the collection of the South Australian Museum.

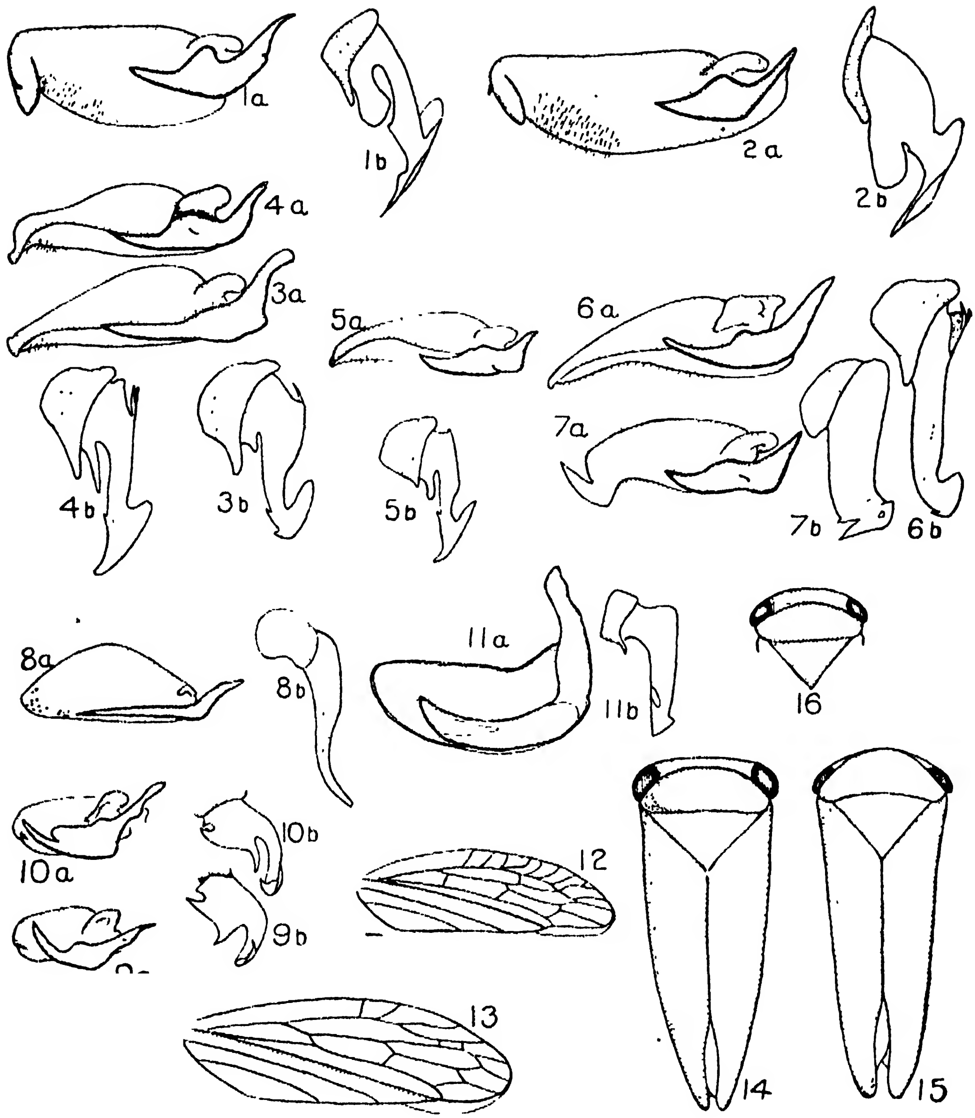

Fig. B.

Figure 1a *Ipoella fidelis*, subgenital plate and paramere.
„ 1b „ „ aedeagus.
„ 2a *Ipoella canberrensis*, subgenital plate and paramere.
2b „ „ aedeagus.
3a *Anipo porriginosa*, subgenital plate and paramere.
3b „ „ aedeagus.
4a *Anipo brunneus*, subgenital plate and paramere.
4b „ „ aedeagus.
5a *Anipo unimaculata*, subgenital plate and paramere.
5b „ „ aedeagus.
6a *Katipo rubrivenosa*, subgenital plate and paramere.
6b „ „ aedeagus.
7a *Katipo signoreti*, subgenital plate and paramere.
7b aedeagus.

(Continued on opposite page)

Ipoella canberrensis, n. sp.

Description.—Length, 7 mm. Head, width, 2·5 mm., pale yellow with a large dark T-shaped mark; crown, grey mottled with brown. Pronotum, greyish-brown mottled with black. Scutellum, yellowish-brown mottled with black. Tegmen, hyaline, largely suffused with dark brown, with an indistinct anterior transverse hyaline fascia. Thorax, ventral surface black. Legs, femora pale brown, tibiae streaked with pale and dark brown. Abdomen, ventral surface dark brown. Male genitalia as in fig. B, figs. 2a and 2b. Host plant, *Eucalyptus* spp.

Distribution.—Federal Capital Territory.

Type, ♂ from Canberra (coll. J. W. E.), in the collection of the C.S.I.R. Division of Entomology at Canberra.

Ipoella insignis Distant.

Eurymeloides insignis Dist., Ann. Soc. Ent. Belg. 52; 103, 1908.

It is very probable that this species belongs to this genus, but since the type specimen is a female, this point cannot be definitely settled until more material is available for study. The description given below is of the type specimen.

Description.—Length, 7 mm. Head, width, 2·5 mm., yellowish-brown, the maxillary plates whitish. Pronotum, pale yellowish-brown. Scutellum, pale chestnut-brown. Tegmen, chocolate-brown, with two transverse fasciae, the anterior white and opaque, the posterior transparent and widest at the costal margin of the tegmen; clavus, pale yellowish-brown. Thorax and abdomen, ventral surface, pale yellowish-brown. Legs, femora, pale yellowish-brown; tibiae marked with an irregular pattern of yellow and brown; tarsi dark brown, but for the first tarsal segment of the hind tibiae, which are white.

Type, ♀ from Queensland, in the collection of the British Museum.

Anipo, gen. nov.

This genus differs from the preceeding one, to which it is closely related, principally in the structure of the male genitalia. The hind tibiae have one spur and no additional spines.

Anipo porriginosa Signoret. (Genotype.)

Eurymela porriginosa Sign., Ann. Soc. Ent. Fr. (2) viii.; 51, 1850.

Bythoscopus luridus Walker, List Homopt. iii.; 870, 1851.

Description.—Lengh, 7 mm. Head, width, 2·6 mm., pale yellowish-brown. Pronotum, reddish-brown mottled with grey. Scutellum, chestnut-brown. Tegmen, hyaline, veins pinkish. The tegmen may be dotted with white spots or have

Fig. B (continued).

Figure 8a	..	*Citripo flandersi*, subgenital plate and paramere.
8b		aedeagus.
9a		*Pauripo insularis*, subgenital plate and paramere.
9b		,, ,, aedeagus.
10a		*Pauripo continentalis*, subgenital plate and paramere.
10b		,, ,, aedeagus.
11a		*Opio multistrigia*, subgenital plate and paramere.
11b		,, ,, aedeagus.
12		*Anipo porriginosa*, tegmen.
13		*Opio multistrigia*, tegmen.
14		*Opio multistrigia*.
15		*Anipo brunneus*.
16		*Citripo flandersi*, dorsal surface of head and thorax.

an anterior white fascia varying in shape (fig. B, fig. 12). Thorax and abdomen, ventral surface pale yellowish-brown. Legs, pale brown. Male genitalia, as in fig. B, figs. 3a and 3b. Subgenital plates narrower and the parameres longer than with the previous genus; aedeagus with anterior dorsal spines in addition to a posterior ventral flap. Host plant, *Eucalyptus* spp.

Distribution.—Queensland, New South Wales and South Australia.

Anipo brunneus, n. sp. (Fig. B, fig. 15.)

Description.—Length, 5 mm. Head, width, 2·2 mm., yellowish-brown, eyes red. Pronotum, yellowish-brown spotted with white. Scutellum, yellowish-brown. Tegmen, hyaline, greenish-yellow in colour. Thorax and abdomen, ventral surface, very pale yellowish-brown. Legs, yellowish-brown. Male genitalia, as in fig. B, figs. 4a and 4b. Very similar to those of the genotype. Host plant, *Eucalyptus* spp.

Distribution.—New South Wales.

Type, ♂ from Canberra F.C.T. (coll. A. L. Tonnoir), in the collection of the C.S.I.R. Division of Entomology at Canberra, described from a long series of males and females.

Anipo unimaculata, n. sp.

Description.—Length, 5 mm. Head, width, 2·2 mm., yellowish-brown, vertex and crown chestnut brown, eyes red. Pronotum, deep chocolate-brown, the posterior margin whitish. Scutellum, pale brown. Tegmen, pale yellowish-hyaline but for an area between the radius and the costa, not extending as far as where the median vein leaves the radius, which is very dark brown or black. Thorax, ventral surface, very dark brown or black and yellowish. Legs, yellowish, excepting the distal three-quarters of the hind femora and the proximal halves of the hind tibiae, which are dark brown. Abdomen, ventral surface, very pale yellowish-brown. Male genitalia, as in fig. B, figs. 5a and 5b. Very similar to those of the genotype.

Distribution.—Queensland.

Type, ♂ from Brisbane (coll. H. Hacker), paratypes 1 ♂ and 2 ♀'s. Type and paratypes in the collection of the South Australian Museum.

Katipo, gen. nov.

This genus can be distinguished from the two previous ones, to which it is closely related by the character of the hind tibiae, which bear two distinct spurs in addition to numerous spines.

KATIPO RUBRIVENOSA Kirkaldy.

Eurymeloides rubrivenosus Kirk., H.S.P.A. Exp. Sta. Bull. 1 (9); 353, 1906.

Eurymeloides lentiginosus Kirk., H.S.P.A. Exp. Sta. Bull. 1 (9); 353, 1906.

Description.—Length, 5 mm. Head, width, 2·3 mm., black or brown with yellow spots, the maxillary plates and the external margins of the frons and lorae, yellowish. Pronotum, black or brown with cream coloured spots, the anterior lateral angles brownish. Scutellum, brown. Tegmen, claval and proximal area brown, the rest black with several round transparent areas, and a large area against the distal costal margin, usually transparent; veins pink; there may be an indistinct narrow white median transverse fascia, seldom extending into the clavus. Thorax, ventral surface, black or yellow. Legs, entirely black, entirely brown, or black and brown. Abdomen, ventral surface pale brown or black. Male genitalia, as in fig, B, figs. 6a and 6b. Similar to those of *Anipo* spp.; the aedeagus without an anterior ventral process. Host plant, *Eucalyptus* spp.

Distribution.—Queensland, New South Wales and South Australia.

Katipo signoreti, n. sp.

Description.—Length, 5 mm. Head, width, 2·2 mm., yellowish-brown; with or without a median black longitudinal stripe stretching from the base of the clypeus to the dorsal margin of the frons; crown and vertex black, spotted with cream and white. Pronotum, grey mottled with black, or pale brown. Scutellum, coloured with a variable pattern of brown and black, or entirely brown. Tegmen, hyaline, suffused with pale brown and dotted with numerous round transparent and whitish spots. Thorax, legs and abdomen, yellow and black, or entirely yellowish. Male genitalia, as in fig. B, figs. 7a and 7b. Subgenital plates with an apical hook-like process, aedeagus without any posterior dorsal spines. Host plant, *Eucalyptus* spp.

Distribution.—New South Wales.

Type, ♂ from Canberra, F.C.T. (coll. J. W. E.), in the collection of the C.S.I.R. Division of Entomology at Canberra.

Citripo, gen. nov.

This genus differs from the preceding ones in being less narrowly wedge-shaped. The head is visible from above as a broad even band. The tegmen has only a few (1-5) costal cells. The hind tibia has only one spur in addition to numerous strong spines, and the male genitalia are differently shaped.

Citripo flandersi, n. sp.

Description.—Length, 5 mm. Head (fig. B, fig. 16), width, 2·3 mm., black, the frons, crown and vertex mottled with yellow, the rest of the head is similarly coloured, but the black areas are less dense; eyes black. Pronotum and scutellum, yellowish-grey mottled with black. Tegmen, hyaline, densely mottled with dull brown; an anterior opaque somewhat rounded fascia, surrounded by an opaque black area. Thorax and abdomen, ventral surface, black. Legs, blackish-brown with white spots. Male genitalia as in fig. B, figs. 8a and 8b. Parameres long and narrow, aedeagus simple. Host plant, *Eremocitrus glauca* (Native Lime).

Distribution.—Queensland.

Type, ♂ from Queensland (coll. S. Flanders), in the collection of the C.S.I.R. Division of Entomology at Canberra.

Pauripo, gen. nov.

This genus contains two small squat species, which differ from each other principally in the characters of the male genitalia. Head, broad, the frons more or less hexagonal; maxillary plates broad; only a narrow border of the crown visible dorsally. Pronotum narrow. Tegmina tectiform apically, appendix continuing narrowly round the apex. Hind tibia with a large spur on one of the inner edges and two somewhat smaller ones on the other. Male genitalia with small styles on the ventral edges of the small subgenital plates.

NOTE.—This genus is included in the Ipoinae on account of its general resemblance to insects in the preceding genera, although the development of a style on the subgenital plates suggests relationships with the Eurymelinae.

Pauripo insularis, n. sp. (Genotype.)

Description.—Length, 4 mm. Head, width, 1·5 mm., chestnut-brown suffused to a varying extent with very dark brown or black, the maxillary plates and lorae frequently paler than the rest of the head. Pronotum, greyish-brown mottled with dark brown. Scutellum, black. Pronotum, hyaline, mottled with dull brown, especially in the claval area; veins brown or pink. The tegmina may

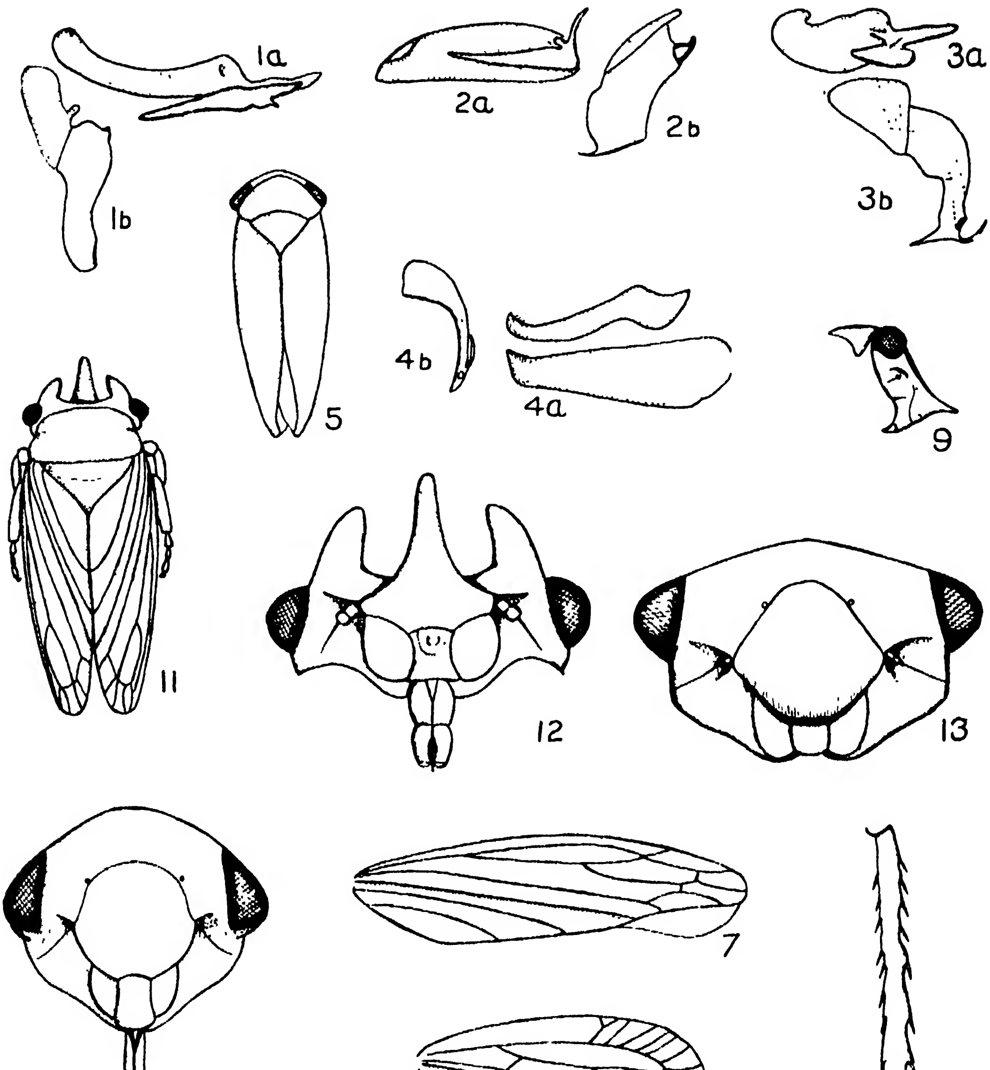

Fig. C.

Figure 1a .. *Cornutipo scalpellum,* subgenital plate and paramere.
1b aedeagus.
2a *Anacornutipo lignosa,* subgenital plate and paramere.
2b „ „ aedeagus.
3a *Cornutipoides tricornis,* subgenital plate and paramere.
3b „ „ aedeagus.
4a *Ipocerus procurrens,* subgenital plate and paramere.
4b „ „ aedeagus.
5 *Ipocerus procurrens.*
6 *Ipocerus procurrens,* head.
7 „ „ tegmen.
8 „ „ hind tibia.

(Continued on opposite page)

be entirely hyaline but for the claval area, and in some specimens there are traces of narrow anterior and posterior transverse fasciae. Thorax, ventral surface, pale biscuit colour, suffused to a varying extent with black. Legs, femora, pale yellowish-brown; tibiae with a number of distinct oval white spots, the external edges of the hind tibiae may be dark brown. Abdomen, ventral surface, pale yellowish-brown. Male genitalia, as in fig. B, figs. 9a and 9b. Subgenital plates more or less rectangular with small styles at the apex of the ventral margin; aedeagus with apical spines and an anterior ventral process.

Distribution.—Kangaroo Island, South Australia.

Type, ♂ from Vivonne Bay, Kangaroo Island, paratypes 1 ♂ and 2 ♀'s. Type and paratypes in the collection of the South Australian Museum.

Pauripo continentalis, n. sp.

Description.—Length, 4 mm. Head, width, 1·5 mm., chestnut brown. In some specimens the frons and vertex are black. Pronotum, chestnut, or very dark brown, mottled with black. Scutellum, black. Tegmen, dull brown with irregular hyaline areas, these are largely transverse; veins brown or pinkish. Thorax and abdomen, ventral surface, pale brown. Legs, pale yellowish-brown, the tibiae with a number of oval white spots. Male genitalia, as in fig. B, figs. 10a and 10b. The parameres are broader than those of the genotype, and the aedeagus a little differently shaped.

Distribution.—South Australia.

Type, ♂ from Lucindale, South Australia (coll. A. H. Elston); paratypes, 3 ♀'s, one from the type locality and two from Adelaide.

Cornutipoini.

The insects comprised in this genus and in the two following genera, though not superficially resembling each other, are evidently fairly closely related, morphologically in the character of the production of the frons into a ledge, spatulate process or a horn, and also as evidenced by the general colouration. While *A. lignosa* is widely distributed in the more settled areas of the continent, *C. scalpellum* appears to be confined to the arid interior regions, and *C. tricornis* to North-Western Australia.

Anacornutipo, gen. nov.

Narrowly wedge-shaped, head nearly twice as broad as long, maxillary plates wide, the frons, vertex and crown, all but the dorsal margin, flat; the anterior edge of the frons is produced so that it overhangs the clypeus, which is almost at right angles to it. The femora of the first two pairs of legs bear a row of short blunt spurs on their interior edges, and the hind tibiae have one spur and a few very small spines.

ANACORNUTIPO LIGNOSA Walker. (Genotype.)

Eurymela lignosa Walker, Homopt. Ins. Suppl. 166, 1858.

Description.—Length, 4·8 mm. Head (fig. C, fig. 13), 2·2 mm. wide, brown mottled with dark brown or black. Pronotum and scutellum, concolorous with the tegmina. Tegmen, opaque, dull brown, chocolate-brown or blackish-brown, with irregular white markings; in some specimens these are arranged as fasciae; the

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Fig. C (continued).

Figure 9	..	*Cornutipo scalpellum*, head in profile.
10		„ „ tegmen.
11		*Cornutipoides tricornis*.
12		*Anacornutipo lignosa*, head.
13		„ „ head.

apical third of the tegmen may be whitish-hyaline. Thorax, ventral surface, black. Legs marked with a variable pattern of light and dark brown. Abdomen, ventral surface pale yellowish-brown. Male genitalia as in fig. C, figs. 2a and 2b. Subgenital plates narrow, slightly recurved at the apex dorsally, aedeagus with a posterior dorsal spur or prominence. Host plant, *Eucalyptus,* spp.

Distribution.—All States.

Cornutipo, gen. nov.

Eyes semi-globular, distinctly prominent. Head vertical with vertex flat, the frons strongly recurved and produced at the apex into an angular flap-like process; labium extending to the base of the middle pair of legs; maxillary plates narrow. Pronotum with the anterior and posterior margins almost straight, the lateral margins wide, so that the base of the tegmen is not close to the head; propleuron with a narrow posteriorly-directed process extending over the mesopleuron. Tegmina not tectiform apically, the appendix small. Tibiae flattened, sub-dilated, the hind tibiae with a small spur and no spines. Male genitalia very small, the subgenital plates not nearly reaching to the apex of the abdomen.

Cornutipo scalpellum, n. sp.[4] (Genotype.)

Description.—Length, ♂, 5·5-6 mm.; ♀, 8 mm. Head, width, 2·8 mm., the lorae, clypeus and ventral surface of the frons, whitish-yellow with a few small brown markings, the rest of the head pale yellowish-brown mottled with black (fig. C, fig. 9). Pronotum, greyish-brown, or white mottled with yellow or black, some specimens have a median longitudinal pale stripe. Scutellum marked with a pattern of ochreous and black. Tegmen, greyish or whitish with fuscous punctures, veins pale yellowish-white or brown, the proximal costal and claval areas whitish; some specimens have in addition an irregular whitish or hyaline area towards the apex of the tegmen (fig. C, fig. 10). Thorax, ventral surface black and pale straminaceous. Legs, pale and dark brown. Abdomen, ventral surface pale brown. Male genitalia as in fig. C, figs. 1a and 1b. Resembling those of *A. lignosa* in the shape of the subgenital plates and in the possession of an anterior dorsal prominence on the aedeagus. Host plant, *Eucalyptus dichromophloia* (Lake Mackay).

Distribution.—Queensland and Central Australia.

Type, ♂ from Duaringa, Queensland, in the collection of the British Museum. Described from a long series of both sexes.

Cornutipoides, gen. nov.

The species in this genus resembles *C. scalpellum* in the structure of the prothorax and subgenital plates; also the venation and colouration of the tegmina of the two species is similar. The head bears three horns, the frons being produced into an upward-turning horn, and the vertex on each side between the eyes and the margin of the frons, into two downward and inward-projecting horns. The hind tibiae are quadrilateral in section and bear one spur and a few small spines.

Cornutipoides tricornis, n. sp. (Genotype.) (Fig. C, fig. 11.)

Description.—Length, 6 mm. Head, width, 2·2 mm., punctate mottled with ochreous and very dark brown (fig. C, fig. 12). Pronotum and scutellum, yellowish, mottled with dark brown. Tegmen, hyaline mottled with brown, the claval area, which is on a plane with the scutellum, punctate; veins distinct, brown; there may be incomplete anterior and posterior fasciae. Thorax, ventral surface very dark brown. Legs, pale or dark brown, closely appressed ventrally to the body. Abdomen, ventral surface, pale brown. Male genitalia, as in fig. C, figs. 3a

(4) The late Dr. C. F. Baker had ascribed this name (in manuscript) to this species.

and 3b. Subgenital plates very small, parameres less than half the length of the plates.

Distribution.—North-western Australia.

Type, ♂, paratypes, 1 ♂ and 2 ♀'s; all four specimens in the collection of the South Australian Museum.

Opioni. **Opio,** gen. nov.

This isolated and distinct genus contains only one species. Insects narrowly wedge-shaped; head only slightly wider than long, flat, the maxillary plates, lorae and clypeus being on the same plane as the frons; labium reaching to the base of the hind legs; hind margin of the crown from above, only slightly curved. Hind tibiae with three spurs decreasing in size from the apex of the tibiae to the base.

OPIO MULTISTRIGIA Walker. (Genotype.) (Fig. B, fig. 14.)

Bythoscopus multistrigia Walk., Insecta Saund., Homopt., 105, 1858.

Description.—Length, 7 mm. Head, width, 3 mm., bright yellow with black markings. Pronotum, greyish-yellow with black markings, and a pale median longitudinal stripe. Scutellum, brown and black with two longitudinal yellow bands, which are narrower at the anterior than at the posterior margin. Tegmen (fig. B, fig. 13), long and narrow, black with bright yellow and whitish longitudinal stripes; the posterior costal area may be hyaline. Thorax and abdomen, ventral surface pale yellowish-white. Legs, marked with a pattern of yellow and black. Male genitalia, as in fig. B, figs. 11a and 11b. Host plant, *Casuarina* sp.

Distribution.—New South Wales.

Ipocerus, gen. nov.

Species comprised in this genus have certain characters that separate them from the Eurymelidae, and they cannot be placed in any of the known subfamilies of the Bythoscopidae. The head is Eurymeloid in character, the maxillary plates, frons and lorae being wide and the frontal suture complete anteriorly; the labium is long, reaching to between the bases of the hind legs; and the crown is visible from above as a narrow margin. The pronotum is deeply emarginate, and the scutellum narrow, the anterior corners of the latter not nearly reaching to the sides of the body. The tegmina are not tectiform; they narrow apically and the appendix is large but does not continue round the apex of the tegmen. The hind tibiae bear three rows of spines, three of these on one row being set on enlarged bases, somewhat resembling, but less pronounced than those found in the Eurymelidae proper. The male genitalia consist of long, flat subgenital plates and parameres, both slightly curved inwards apically; they are somewhat Idiocerine in character.

Species in this genus are apparently confined to Western Australia. Mr. D. C. Swan, who collected some specimens of *I. procurrens* in October, 1930, informs me that he took them in the cracks in the bark of *Eucalyptus calophylla,* that the nymphs jumped when disturbed, and that they were not attended by ants.

For convenience this genus is temporarily placed with the Ipoinae, until as a result of further research it becomes possible to assign it either to its correct subfamily or to erect a new subfamily to contain it.

IPOCERUS PROCURRENS Jacobi. (Genotype.) (Fig. C, fig. 5.)

Ipo procurrens Jacobi, Faun. S.-W. Aust., Michaelsen u. Hartmeyer, ii.; 340, 1909.

Description.—Length, 4·8 mm. Head, width, 2 mm., as wide as long, grey or cream-coloured, mottled with brown or black; frons brown with cream-coloured

markings; eyes dark brown (fig. C, fig. 6). Pronotum, concolorous with the head. Scutellum, black with yellowish markings. Tegmen, pale or dark brown with oval, round and irregularly shaped hyaline areas; distal half of appendix, brown (fig. C, fig. 7). Thorax, ventral surface dark brown. Legs, pale yellowish-brown mottled with dark brown, with numerous spines, three of them being set on enlarged bases (fig. C, fig. 8). Abdomen, ventral surface brown. Male genitalia, as in fig. C, figs. 4a and 4b. Subgenital plates and parameres long, narrow and flat, somewhat thickened apically.

Distribution.—South-western Australia.

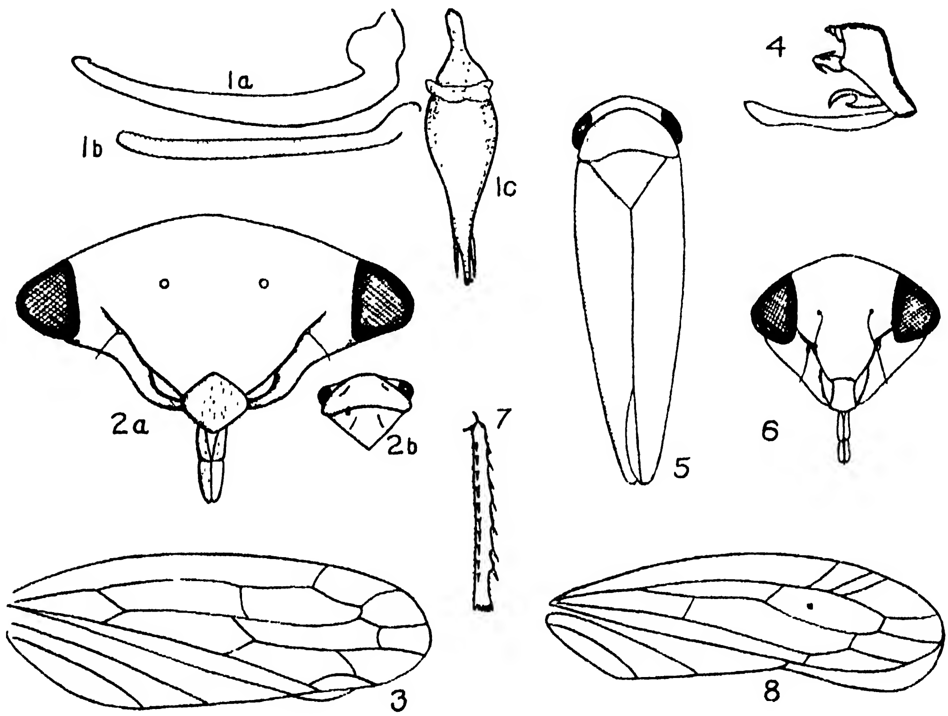

Fig. D.

Figure 1a .. *Stenoscopus drummondi*, subgenital plate.
1b „ „ paramere.
1c „ „ aedeagus.
2a *Stenoscopus drummondi*, head.
2b „ „ dorsal view of head and thorax.
3 „ „ tegmen.
4 *Idiocerus leurensis*, male genitalia, lateral view.
5 *Idiocerus leurensis*.
6 head.
7 hind tibia.
8 tegmen.

Bythoscopidae.
Bythoscopinae. **Stenoscopus**, gen. nov.

Head from above wider than long, the frons, of which the posterior margin is ill-defined, lying on a different plane from the rest of the head. The antennae lie in pits below the overhanging lateral margins of the frons, and the ocelli are

situated on the vertex well away from the frons. The eyes are small but prominent, the lorae small, and the clypeus more or less diamond-shaped. The labium is short, not reaching beyond the bases of the fore legs, and the crown of the head is only visible from above laterally against the eyes. The pronotum is wide at the sides, separating the head from the bases of the tegmina, and the anterior and posterior borders are not parallel to each other. The tegmen has a small appendix and only four apical cells; and the hind tibia is armed with numerous spines that arise direct from the tibia itself. The male genitalia consist of long, narrow subgenital plates and parameres, and a flask-shaped aedeagus.

Stenoscopus drummondi, n. sp. (Genotype.)

Description.—Length, 7 mm. Head, width, 2·2 mm., rugose, ochreous, with a pattern of well-defined but variable, very dark brown markings; eyes pale or dark reddish-brown (fig. D, figs. 2a and 2b). Pronotum, dull yellow with dark brown markings. There are two lateral depressions close to the anterior border. Scutellum, bright yellow; lateral angles black. Tegmen, transparent, veins black; venation as in fig. D, fig. 3. Thorax and abdomen, ventral surface and legs dull yellow. Male genitalia as in fig. D, figs. 1a, 1b and 1c.

Type, ♂, from Beverley, Western Australia; paratypes, 2 ♀'s from Bruce Rock, Western Australia (coll. F. Drummond). Type and one of the paratypes in the collection of the South Australian Museum.

Idiocerinae. *Idiocerus* Lewis (type, *I. adustus* H.).

The characters given below are not necessarily of generic significance within the Idiocerinae, but are sufficient to enable the separation of insects belonging to this genus from the Eurymelidae.

Head, triagular in shape; eyes big, not prominent; ocelli lying at the apices of the lateral margins of the frons; clypeus more or less rectangular; maxillary plates narrow, the external margins straight, not curved; antennae long, the flagellae projecting well beyond the sides of the head; labium extending as far as the middle pair of legs. Head from above, the crown broad and as wide in the centre as against the eyes. Tegmen with only two subapical cells between the radius and the cubitus, the appendix very large. Hind tibia with three rows of spines that decrease in size from the apex of the tibia to the base. Male genitalia with the subgenital plates long and narrow, extending well beyond the apex of the abdomen. The parameres are short and flat and do not extend as far as the middle of the plates.

Idiocerus leurensis, n. sp. (Fig. D, fig. 5.)

Description.—Length, 8 mm. Head, width, 2·1 mm., yellowish; eyes, dull red (fig. D, fig. 6). Pronotum and scutellum, pale greenish-yellow. Tegmen, pale greenish, hyaline, veins yellow (fig. D, fig. 8). Thorax and abdomen, ventral surface and legs pale yellow. Male genitalia as in fig. D, fig. 4.

Type, ♂, from Leura, New South Wales (coll. J. W. E.); paratypes, 2 ♀'s, one from the type locality, and one from "Blundells," F.C.T. Type and one of the paratypes in the collection of the C.S.I.R. Division of Entomology at Canberra.

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The author wishes to acknowledge the assistance given him, in the preparation of this paper, by Mr. W. E. China, of the British Museum. He is also indebted to the authorities in charge of the Queensland, Australian, National and South Australian Museums, for permitting him to examine the collections in their care.

ADDITIONS TO THE FLORA OF SOUTH AUSTRALIA.

No. 32.

By J. M. Black, A.L.S.

[Read October 11, 1934.]

Plates X. and XI.

Pinaceae.

Callitris Drummondii (Parlat.) Benth. et Hook. Kulde, near Karoonda, *J. B. Cleland;* also grown at Blackwood by E. Ashby from seed obtained at Middle River, Kangaroo Island. This species, whose type came from Western Australia has now been found in our State on Eyre Peninsula, Kangaroo Island, and Murray lands.

Gramineae.

**Stenotaphrum secundatum* (Walt.) O. Kuntze. This "Buffalo Grass," much used for lawns, has established itself in many moist places, sometimes close to the sea, as at the mouth of the Inman River. This is the American species and differs from *S. dimidiatum* (L.) Brongn., the East African and South Indian grass, in having the spikelets 1-3 together in the cavities of the flat rhachis of the spike, instead of 3-5, or even more, in each cavity. The authorities at Kew, who kindly determined our specimens, add: "*S. dimidiatum* has softer and greener foliage than *S. secundatum* and should be better than that species for making lawns." The former has the spike finally exserted from the leaf-sheath on a long peduncle, while *S. secundatum* has the peduncles enclosed in or shortly exserted from the sheath.

Triodia aristata, J. M. Black. Nonning (Gawler Ranges), August, 1928, *J. B. Cleland;* near Mount Kintore (S.-W. of Musgrave Ranges), July, 1933, *Tindale and Hackett.*

Stipa variabilis, Hughes. It is worth noting that this species, and perhaps others belonging to Miss Hughes' section *Falcatae,* have the upper part of the awn straight or almost so in the living state, and that it is in the dried condition that this part of the awn becomes falcate, *i.e.,* curved like a sickle or bent bow.

**Bromus scoparius,* L. Kingscote, Kangaroo Island, November, 1933, *A. B. Cashmore.* Not previously recorded for South Australia, but naturalized in Victoria since 1898.

Cyperaceae.

Tetraria monocarpa, nov. comb. The study of further specimens from near Mount Compass and the Hindmarsh Valley convince me that this plant should be placed in the genus *Tetraria,* Beauv., of which it has the characters. *Tetraria* differs from *Cladium, Gahnia* and *Lepidosperma* in the glumes distichous or almost so (not spirally arranged round the rhachilla), from *Schoenus* by the rhachilla short and straight (not lengthened and flexuose under the flowering glumes), and the spikelet only 2-flowered, the lower flower male or barren, the upper one fertile and nut-bearing. In this species the spikelets are very slightly compressed, at first almost subulate, 6-9 mm. long, about 1 mm. broad, with 8-9 distichous glumes, the first 5 or 6 empty, the 6th or 7th bearing a male flower with 3 stamens or a perfect but sterile flower, the 7th or 8th with a pistil and 3 stamens and ripening the solitary nut, the 8th or 9th glume empty and rather smaller; the 4 uppermost glumes are 5-6 mm. long, obtusely notched,

with a mucro usually shorter than the rounded lobes; style 3-branched, articulate on the nut, which is obovoid, trigonous from summit and shows scarcely any sign of an adherent style-base. In the words of C. B. Clarke, the style-base must be considered as "confluent with the rounded summit of the nut," which is sometimes the case in *Tetraria* as defined by that author; hypogynous bristles none (pl. x., fig. 4).—*Schoenus monocarpus,* J. M. Black in Trans. Roy. Soc. S. Aust., 52 : 225 (1928); *Cladium monocarpum,* J. M. Black *l.c.* 53 : 261 (1929).

Appears to be endemic in the Mount Lofty Range and Kangaroo Island.

Tetraria capillaris (F. v. M.) nov. comb. This also appears to be a *Tetraria,* as it has distichous glumes, a straight rhachilla and usually 2 flowers, of which only the upper one is fertile. The spikelets are about 5 mm. long, 1¼-1½ mm. broad, acute, with 5-6 glumes, the first 3 or 4 empty and smaller, the 3rd or 4th glume enclosing a barren flower consisting of pistil and 3 stamens or sometimes empty, the 4th or 5th with a fertile flower, and the 5th or 6th empty, small, membranous, pubescent towards summit; style 3-branched, with a conspicuous conical scabrous base, which is persistent on and as long as the nut; no hypogynous bristles. The stems are numerous and capillary (less than ¼ mm. diam.) (pl. x., fig. 5).—*Chaetospora capillacea,* Hook. f. Fl. Tasm. 2 : 81, t. 141 A (1855-59) non Nees in Linnaea 10 : 192 (1836); *Ch. capillaris,* F. v. M. Fragm. 9 : 34 (1875); *Elynanthus capillaceus,* Benth. Fl. Aust. 7: 377 (1878); *Schoenus capillaris,* F. v. M. in Journ. Roy. Soc. N.S.W., 27 : 85 (1893); *Cladium capillaceum* (Hook f.) C. B. Clarke, M.S. fide Cheeseman, N.Z. Fl. 789 (1906).

The name *T. capillacea* cannot be adopted for our plant because it is already occupied by *T. capillacea* (Thunb.) C. B. Clarke in Consp. Fl. Afr. 5 : 659 (1895), a South African species. *Elynanthus,* to which genus Bentham transferred our plant, is now treated as a section of *Tetraria.* In our State *T. capillaris* has only been found on Kangaroo Island; it also inhabits Victoria and Western Australia.

Schoenus deformis (R. Br.) Poir. (1811). Goolwa Road, 2 miles from Middleton, on travertine limestone, January, 1934, *J. B. Cleland* (pl. x., fig. 7). At first these specimens suggested a new species, because each spikelet had evidently 2 subulate involucral bracts, of which the lower one is 2 to 3 times as long as the 3-flowered spikelet, which is 12 mm. long and 2½ mm. broad, and the upper bract is about as long as the spikelet. R. Brown's originals were gathered at Memory Cove, south of Port Lincoln, over 130 years ago, and as they are preserved in the Natural History Section of the British Museum, one of the specimens collected on the Goolwa Road was sent to Kew for comparison. Mr. Ballard reports:—"There is no doubt that the 2 are identical. There are 2 involucral bracts subtending the spikelet in the Brown specimen, in spite of the statement to the contrary in the Flora Australiensis." Brown's original description (Prodr. 232) also overlooks the shorter bract. This small rush, 5-12 cm. high, has only been found in the 2 localities mentioned and appears to be endemic in South Australia. The brown basal leaf-sheaths, bearded at summit, are 1-2 cm. long, and the blades are filiform, channelled, minutely ciliolate on the margin and from ½ to nearly as long as the stems.

AMARYLLIDACEAE.

Calostemma purpureum, R. Br. The depressed-globular fruit has a purplish-brown, membranous, longitudinally 6-nerved pericarp, adherent to which is the solitary seed, with a thin membranous testa and a hard albumen (endosperm) surrounding the embryo. In spite of Bentham's statements in the Fl. Aust. and the Gen. Pl. the fruit is not succulent, but hard and solid.

The structure and germination of the seed of this and other Amaryllidaceous plants has been discussed by Robt. Brown in his Prodr. 298 (1810), and Trans. Linn. Soc. 12 : 143 (1818) ; by Achille Richard in Ann. Sci. Nat. série 1 : 2 : 12 (1824) ; by Prillieux, *l. c.* série 4 : 9 : 97 (1858), and by H. Baillon in Bull. Soc. Linn. Paris, p. 4 (1874).—"Sur le développement et la germination des graines bulbiformes des Amaryllidées." This paper is not available here, but a short note by Pax in the Nat. Pflanzenfam. (1889) says that according to Baillon *Calostemma* has no normal embryo in the embryo-sac, but develops a bulbil instead.

The drawings on pl. xi., fig. 3, show progressive stages in the germination of the seed, which is at first tightly enclosed in the pericarp of the fruit. The seeds germinated while lying dry in a drawer; they were then transferred to moist flannel and afterwards to a pot, where they attained the development shown in fig. 3, I and J.

I leave to embryologists the task of investigating further the true nature of the seed and its germination, only observing that in this monocotyledonous plant there emerge from the seed 1 to 3 cotyledons, 2 being apparently the most usual number.

Iridaceae.

**Watsonia Meriana* (L.) Mill. This bulbous plant, from about 1½ to 2 m. high, with handsome pink or red funnel-shaped curved flowers and sword-shaped equitant leaves 2-3½ cm. broad, may now be considered established in the Mount Lofty Range, usually in gullies and near creeks. Flowers October-November.—A native of South Africa, it is a garden escape here and in the eastern States.

Restionaceae.

Leptocarpus Brownii, Hook. f. Waitpinga Road and Hall's Creek Hills, both near Encounter Bay, *J. B. Cleland.* Hitherto only collected on Eyre Peninsula and in the South-East.

Casuarinaceae.

Casuarina Decaisneana, F. v. M. Plain between Musgrave and Mann Ranges, June, 1933, *Tindale and Hackett.* This is the first record of the "Desert Oak" in South Australia. It has previously been collected at Mount Mueller, south of the Roper River, N.A., and in the MacDonnell Range and near the Finke River, C.A. In our specimens the cones are 4½-5 cm. long by about 3 cm. diam.

Proteaceae.

Hakea lorea, R. Br. Leaves terete, simple, ashy-grey, minutely pubescent, 20-60 cm. long, 2-2½ mm. diam.; perianth densely pubescent with hairs about 1 mm. long, the tube 10-12 mm. long.

Arkaringa Creek; Everard Range; Musgrave Ranges to Western Australian border. West and Central Australia; Western New South Wales and Queensland.

Hakea Ivoryi, Bailey. Leaves terete, once or twice forked or trisect, rarely simple, greyish-green, smooth and only microscopically appressed-pubescent, 5-18 cm. long, about 1½ mm. diam., the segments 4-10 cm. long; perianth pubescent with hairs about ½ mm. long, the tube 6-8 mm. long.

Musgrave Ranges.—Western New South Wales (Darling and Paroo Rivers); Queensland (near Cunnamulla on the Warrego).

Hakea intermedia, Ewart et Davies. Leaves terete, ashy-grey, 1-3 times forked or trisect, usually 4-7 cm. long, rarely 10 cm. long, about 1½ mm. diam.,

smooth, the segments 1-3 cm. long, more divergent and paler than in *H. Ivoryi;* perianth pubescent as in the latter, the tube about 8 mm. long.

North of Cooper's Creek. Central Australia (along Finke River). Western New South Wales and Queensland.

Hakea Ednieana, Tate. Near *H. intermedia* in the leaves, which are 1½-4 cm. long, about 1 mm. diam., ashy-grey, once or twice forked or trisect, smooth but appressed-pubescent under the lens, whereas those of *H. intermedia* are almost glabrous, the segments strongly divergent, ½-2 cm. long; perianth densely whitish-pubescent, the tube only 4 mm. long.

Aroona Range, Mount Lyndhurst, Leigh's Creek, Blinman, Mooloolool (all in Flinders Range) and apparently endemic.

All these species have, as far as we know, no involucral bracts covering the young flowers in the raceme and therefore belong to the section *Grevilleoides,* Benth., which is also distinguished by an obliquely lateral stigmatic disk. *H. Ednieana* has, however, in contradistinction to the other 3 species, an erect stigmatic cone, which is a character of the section *Conogynoides,* another character of that section being the involucral bracts on the young raceme. The very young racemes require examination to decide whether they are naked or involucrate. In all 4 species the bark is rough and somewhat corky, the leaves or their segments are rigid and pungent-pointed, the hairs are centrifixed, the young capsule is almost oblong in outline, and the seed-wing is only decurrent for a very short way along one side of the nucleus.

H. lorea, R. Br. var. *fissifolia,* F. v. M. Fragm. 6 : 190 (1868). The size of the leaves is not described; the localities given are Darling River, New South Wales, and sources of Gilbert River, Queensland. The Queensland specimen, lent me by the Victorian National Herbarium, shows leaves once or twice forked, the longest 17 cm., the segments 6-7 cm. long. Maiden (For. Fl. N.S.W. 5 : 159) mentions specimens from that State with segments 1-1½ inch (2½-3¾ cm.) long. It seems possible, therefore, that var. *fissifolia* is a mixture, the Queensland specimens being perhaps *H. Ivoryi,* and those from New South Wales *H. intermedia.*

SANTALACEAE.

Santalum lanceolatum, R. Br. The typical broad-leaved form has again been found in South Australia—this time by Messrs. Tindale and Hackett between the Musgrave and Mann Ranges, June, 1933. Some of the leaves are very obtuse or even notched. "An important native fruit, called *koparta*"—note of the collectors.

LORANTHACEAE.

Loranthus grandibracteus, F. v. M. Cooper's Creek to Pandi Pandi, fruiting August, 1934, *J. B. Cleland.* Berry (not previously described) ovoid-oblong, pale-yellow, 8-10 mm. long.

POLYGONACEAE.

Polygonum glabrum, Willd. Perennial, creeping in mud (at base), glabrous except for a row of minute erect hairs along margin of leaves as in *P. lapathifolium;* stems about 175 cm. high and at least 1 cm. thick; leaves lanceolate, 10-15 cm. long or more, 10-18 mm. broad; petioles 1-2½ cm. long; spikes 2½-3 cm. long.

Diamantina River at Pandi Pandi Station, September, 1934, *J. B. Cleland.*

Danser, in Proc. Roy. Soc. Qld. 39 : 3 : 23 (1927), first records this Asiatic, African, and American species for Australia (Aramac, Qld.), and adds:—"Except for its glabrous character, it is difficult to distinguish it from *P. attenuatum, celebicum* and *javanum.*"

CHENOPODIACEAE.

Chenopodium.

The following arrangement of 4 sections of *Chenopodium* is based on a revision published by Mr. Paul Aellen, of Bâle, a specialist in *Chenopodiaceae,* in Engler's Botanisches Jahrbuch (1930), Verhandlungen der Naturforschenden Gesellschaft in Basel (1930), and the same (1933).

The genus *Dysphania* has been a trouble to botanists for more than a century. Its creator, Robert Brown, placed it next to *Chenopodium,* and Bentham followed his example in the Fl. Aust. (1870). In the Genera Plantarum (1883), however, Bentham and Hooker transferred it to *Illecebraceae.* Other botanists —Baillon (1888), Pax (1889)—placed it in *Caryophyllaceae,* while in 1927 Pax and Hoffmann created for its reception a new family—*Dysphaniaceae.*

There is much to be said in favour of Aellen's inclusion of *Dysphania* in *Chenopodium.* His sections *Dysphania, Tetrasepala* and *Atriplicina* show a gradual ascent from 1 perianth-segment to the 5 segments which normally characterise *Chenopodium.* All three, as well as the section *Orthosporum,* have chiefly female flowers in each cluster, and where the uppermost flowers are bisexual, or rarely male, there is only 1 stamen. The seed is erect and the embryo encircles only about ¾ of the albumen, the cotyledons lying towards the upper end of the seed and the radicle being inferior. In the illustrations of Mueller's Iconography of Australian Salsolaceous Plants the embryos in the section *Orthosporum* are shown as completely annular, with cotyledons and radicle both at the base of the seed, but my examination of seeds in that section indicates that the length and position of the embryo are the same as they are shown in Mueller's illustrations of Dysphania, i.e., the embryo is too short to encircle more than ¾ of the albumen. Bentham and Hooker, in describing the section Orthosporum, say:—"Semen erectum, embryone imperfecte annulari," which agrees with my observations. If *Dysphania* were retained as a genus, it would therefore seem that the 3 sections, *Orthosporum, Atriplicina,* and *Tetrasepala,* should be detached from *Chenopodium* and united with *Dysphania.* Aellen's proposal appears to be the simpler and better one.

Section *Orthosporum,* R. Br. Perianth-segments normally 5, concave inside, narrowed and not hooded at summit, not swollen or gibbous at base; flowers in each cluster mostly female, the terminal ones usually bisexual with only one stamen; style 2-branched; fruit consisting of the hyaline adherent pericarp, the crustaceous testa and the vertical dark-red compressed-obovoid seed; embryo encircling about ¾ of the albumen and therefore dorsal and horseshoe-shaped; pubescent, prostrate or ascending herbs; flower-clusters axillary.

A. Perianth-segments narrow, erect or slightly incurved at summit, whitish when ripe.
  B. Segments narrow-linear, rounded on back, hairy towards summit .. .. *Ch. pumilio* 1
  B. Segments pointed at summit, each with a conspicuous sharply-toothed or fringed vertical wing or crest along the keel .. *Ch. cristatum* 2
A. Perianth-segments broad, keeled, horizontally incurved, thickened and usually black when ripe .. .. *Ch. melanocarpum* 3

Section *Atriplicina,* Aellen. Perianth-segments normally 4, dilated, hardened and gibbous near base; otherwise as *Orthosporum.*

Almost glabrous plant .. .. *Ch. atriplicinum* 4

Section *Tetrasepala,* Aellen. Perianth-segments 4, greenish, slightly hooded; flower-clusters in long leafless spikes; otherwise as in *Orthosporum.*

Perianth and leaves glandular-pubescent .. .. *Ch. rhadinostachyum* 5

Section *Dysphania* (R. Br.) Aellen. Perianth-segments 1-3, hooded, white reticulate and almost hyaline when ripe; flower-clusters spicate or axillary; style simple or 2-branched; otherwise as in *Orthosporum*.

C. Flower-clusters forming a dense leafless spike; perianth-segments 3.
  D. Segments free, erect, shortly stalked .. .. .. *Ch. plantaginellum* 6
  D. Segments united in a cup at base, finally horizontal .. *Ch. simulans* 7
C. Flower-clusters axillary, crowded or distant in a leafy spike; perianth-segments erect.
  E. Segments 1 or 2, easily separating; style 2-branched .. *Ch. myriocephalum* 8
  E. Segments 3, rarely 2, united at base; style simple .. *Ch. Blackianum* 9

1. *Ch. pumilio,* R. Br. Prodr. 407 (1810). This name, given by Brown to a small form from Kangaroo Island, has been ignored by all authors since Brown and Bentham, and has been treated as synonymous with *Ch. carinatum,* R. Br. Aellen, after studying Brown's originals, concludes that the name *pumilio* must be reserved for the species with linear almost erect perianth-segments, rounded on the back, hairy near the summit and without any appendages. The leaf-blades vary from small and entire to 2½ cm. long and sinuate-lobed, with a slender petiole nearly as long as the blade (pl. x., fig. 8).—*Ch. carinatum,* auctt. pro parte non R. Br.

South Australia.—Adelaide Plains; Mount Lofty Ranges, Ardrossan, Yorke Peninsula; Dudley Peninsula, Kangaroo Island; River Murray; Gladstone; Beresford Springs. All the Australian States. One of the Gladstone specimens has prostrate stems only 2-4 cm. long and entire leaves 3-5 mm. long, thus coming very near to the description of Brown's type. The Kangaroo Island specimens have also mostly entire leaves.

The true *Ch. carinatum,* R. Br. and partly of Bentham and most other botanists, is recorded from New South Wales (the type came from Port Jackson), Queensland, and Western Australia, but not from Victoria or South Australia. Brown describes the perianth-segments thus:—"Perianthiis alato-carinatis hispidis." Aellen, in Verh. Naturf. Ges. Basel 44 : 1 : 313 (1933), says:—"Perianth usually longer than broad, elongated, delicately scarious or slightly herbaceous, light-coloured, the segments usually closely beset with hairs, fringes and protuberances, the keel usually most strongly developed in the upper part of the perianth-segments, not conspicuously rounded on the angle, usually winged in the upper part."

The figure here given (pl. x., fig. 9) is copied from one of those published by Aellen, *l.c.*, p. 316. Synonyms:—*Ch. holopterum,* Thellung et Aellen in Mitt. Naturf. Ges. Soloth. Heft 8 : 57 (1928); *Ch. trigonocarpum,* Aellen in Verh. Naturf. Ges. Basel 41 : 99 (1930); *Ch. cristatum,* F. v. M., var. *holopterum,* Thellung in Vierteljahrsschr. Naturf. Ges. Zürich 64 : 724 (1919).

Aellen divides *Ch. carinatum* into 2 varieties: var. *holopterum,* which, as he states, *l.c.*, p. 312 = R. Brown's type, and var. *melanocarpum,* which I deal with below.

2. *Ch. cristatum,* F. v. M. Fragm. 7 : 11 (1869). This is a well-defined species, easily recognised by the broad vertical wings of the perianth-segments cut into long irregular ciliate teeth (pl. x., fig. 10).

South Australia.—Renmark; Mannum; Lake Barmera; Sutherlands; Mount Bryan, Mount Parry, Woolshed Flat, Moolooloo, Beltana (Flinders Range); Eurelia; Curnamona; Alberga River; Fowler's Bay; Ooldea. All the Australian States.

3. **Ch. melanocarpum,** nov. comb. Herba pilis glanduliferis septatisque praedita; caules procumbentes, rigidi, striati; folia ovato-lanceolata, 1-2½ cm. longa, breviter sinuato-lobata, longe petiolata; glomeruli 12-25-flori, densi, axillares, mox distantes, 3-6 mm. diam.; perianthium fructiferum depressum, circa

2 mm. latum, latius quam longum, deorsum ad medium 5-lobatum, lobis oblongis, obtuse carinatis, durescentibus nigrescentibusque, rarius ad maturitatem viridibus, pilosis, valde et fere horizontaliter incurvis, fructum omnino tegentibus; stamen, dum adest, 1; stylus brevis, ramis 2 stigmatiferis longis; fructus erectus, rubellus, ½-¾ mm. longus; embryo dorsalis, hippocrepicus, dodrantem albuminis cingens, radiculâ inferâ (pl. x., fig. 11).—*Ch. carinatum* var. *melanocarpum,* J. M. Black in Trans. Roy. Soc. S. Aust., 46 : 566 (1922) *Ch. holopterum,* Thellung et Aellen pro parte; *Ch. carinatum,* R. Br. var. *melanocarpum* (Black) Aellen in Verh. Naturf. Ges. Basel 44 : 313 (1933).

South Australia—Moolooloo (Flinders Range); Everard and Musgrave Ranges. Central Australia—Finke River; MacDonnell Ranges; Mount Liebig. New South Wales—Broken Hill. Western Queensland. Western Australia—Mount Squires, near Cavanagh Range.

Now that the original *Ch. holopterum* (misquoted in Fl. S.A. 683 as *Ch. holocarpum)* has been recognised by Aellen as equivalent to Brown's type of *Ch. carinatum,* there seems good reason for raising this variety to specific rank. It is essentially a dry-country plant and is distinguished from all other species by its perianth-lobes, which, although erect and greenish in flower, become later so much incurved as to be horizontal, thickened, hard and usually blackish, closing over the fruit and completely concealing it.

4. *Ch. atriplicinum,* F. v. M. Easily distinguished by its subglabrous character, mostly hastate leaves on long petioles, the fruiting perianth-segments 4, erect, glabrous, whitish, somewhat hardened, acuminate, 2½-3 mm. long, dilated at base into prominent irregular tubercles and partially exposing the fruit, which is 1½ mm. long, rugose-granulate (pl. x., fig. 12).—*Scleroblitum atriplicinum* (F. v. M.) Ulbrich (1934).

Dry districts of South Australia, Victoria, and New South Wales.

5. *Ch. rhadinostachyum,* F. v. M. Perianth 1 mm. long, the lobes hairy, greenish, boat-shaped, connected in the lower half by a pale membrane, hooded at summit and tapering towards base; seed ½-¾ mm. long; plant glandular-pubescent, the leaves sinuate-lobed and petiolate, the flower-clusters in "mouse-tail" leafless spikes, which are sometimes panicled (pl. x., fig. 13). The perianth-segments in Icon. Salsol. Plants, pl. 33, are much too acute.

South Australia—Blyth Range. Central Australia—Finke River; MacDonnell Ranges, Mount Liebig; Macdonald Downs; Connor's Well. Western Australia—Mount Squires; Victoria Desert; Fortescue River.

I have seen no specimen corresponding to *Ch. inflatum,* a new species described by Aellen as having inflated bladdery glabrous perianth-segments and a horizontal fruit. The localities given are Ashburton River, Western Australia, and Bulloo Range, Queensland.

6. *Ch. plantaginellum* (F. v. M.) Aellen in Engl. Bot. Jahrb. 63 : 5 : 487 (1930). "Mouse-tail" spikes 1½-7 cm. long; leaves small, entire; fruiting perianth ½ mm. long by 1½ mm. broad, of 3 whitish glabrous bladdery deeply-hooded segments, their claws forming a short stipes; style simple or rarely 2 distinct styles (pl. x., fig. 14).—*Dysphania plantaginella,* F. v. M. Fragm. 1 : 61 (1858).

South Australia—Mount Lyndhurst; Koonamore. Central Australia—Finke River; MacDonnell Ranges. North Australia—Sturt's Creek. Western Australia—Ashburton River.

7. *Ch. simulans,* F. v. M. et Tate in 2nd Cens. (1889). A small erect glandular-pubescent plant, with petiolate ovate-oblong subsinuate leaf-blades, which are 1-2 cm. long, and dense "mouse-tail" sessile flower-spikes 8-14 cm. long; fruiting perianth 1½ mm. long, 2½ mm. broad becoming whitish, with a cup-like usually papillose fruit-enclosing base and 3 bladdery glabrous incurved

depressed lobes, swollen and rounded above the seed, bordered on the outer margin by short horizontal hyaline wings and completely concealing the smooth fruit, which is about ½ mm. long; style 2-branched (pl. x., fig. 15).—*Dysphania simulans,* F. v. M. et Tate in Trans. Roy. Soc. S.A. 8 : 71 (1886) ; *Ch. Osbornianum,* Aellen in Engl. Bot. Jahrb. 63 : 5 : 488 (1930).

South Australia. Salt flats on west side of Lake Eyre, *M. Murray;* Koonamore (north of Broken Hill railway) *T. G. B. Osborn.*

According to Aellen there was no type or co-type of *Ch. simulans* in Europe, and in 1930 he had apparently not seen Mueller's Icon. Salsol. Plants, pl. xxxiv. It seems to have thus come about that he re-described *Ch. simulans* as *Ch. Osbornianum* on a specimen from Koonamore.

8. *Ch. myriocephalum* (Benth.) Aellen in Engl. Bot. Jahrb. 63 : 5 : 488 (1930). Slightly glandular-hairy, with several ascending much-branched stems 10-25 cm. long; leaf-blades ovate-oblong, entire, 2-8 mm. long, on slender petioles; flower-clusters axillary, 1-2½ mm. diam., the lower ones distant, the upper ones approximate or crowded into leafy spikes; fruiting perianth-segments 1 or 2 to each flower, glabrous, bladdery, white, hooded, narrowed towards base, ¾ mm. long; style 2-branched; seed under ½ mm. long; stamen 1, but seldom present; proportion of fruits to perianth-segments observed in various clusters: 24 to 30; 32 to 46; 32 to 37; 25 to 36; 45 to 80 (pl. x., fig. 16).—*Dysphania myriocephala,* Benth. Fl. Aust. 5 : 165 (1870).

South Australia—Swamps and lakes near Murray River at Barmera, Paringa, Morgan, Swan Reach; Lake Boolka; Macumba and Coglin Rivers; Hamilton Bore; Diamantina River; Cordillo Downs. Victoria—River Murray near Mildura. Western New South Wales; Queensland; Western Australia.

9. *Ch. Blackianum, Aellen, l.c.,* p. 487 (1930). Papillose-glandular when young, glabrous or almost so in the adult stage, the stems 5-9 cm. long, the petiolate obovate entire leaf-blades 2-4 mm. long; clusters axillary, the upper ones and those on the short branches crowded together, about 2 mm. diam.; fruiting perianth-segments as in the preceding, but 3 or sometimes 2 to each flower and more united at base; style simple or rarely 2 distinct simple styles; stamen 1, when present; seed about ½ mm. long, shining; proportion of fruits to perianth-segments in clusters examined: 23 to 66; 30 to 84; 20 to 50 (pl. x., fig. 17).—*Dysphania littoralis,* R. Br. Prodr. 411 (1810).

South Australia—Near Marree; Macumba River. Central Australia—Finke River; MacDonnell Ranges. Queensland—Flooded ground near Will's Creek. Northern Australia—Near coast. Western Australia—Mount Squires.

As pointed out by Aellen, Brown's specific name cannot be carried forward into *Chenopodium* on account of *Ch. littorale,* Thunb., a synonym of *Atriplex littoralis,* L., and *Ch. littorale,* Moq., an uncertain Australian species.

These 2 species (Nos. 8 and 9) have so much in common that it is not surprising that they were united by Mueller and most subsequent botanists as *Dysphania littoralis. Ch. myriocephalum* is a larger looser plant than *Ch. Blackianum.*

Bassia.

Dr. E. Ulbrich, in the 2nd edition of Die Natürlichen Pflanzenfamilien, vol. 16c, p. 532, *et seq.* (1934) deals in a painstaking and exhaustive manner with the *Chenopodiaceae.* He transfers all the Australian species now placed in *Bassia* to 5 other genera, of which 3 are new. They are:—*Austrobassia* (fruiting perianth cartilaginous at base); *Dissocarpus* (fruiting perianths hardened and connate in a cluster); *Sclerolaena* (fruiting perianth bony at base); *Coilocarpus* (fruiting perianth coriaceous to the summit), and *Sclerobassia* (fruiting perianth bony to the summit). The name *Bassia* (fruiting perianth membranous) is reserved for some 10 Mediterranean and Asiatic species.

This proposal, involving the re-naming of our Australian *Bassias* (some 50 in number) raises the question as to whether such a sweeping change is justified. The fruiting perianths of our species vary from membranous or coriaceous at base, as in *B. sclerolaenoides* and *B. Muelleri,* to hard and bony, as in *B. bicornis* and *B. paradoxa.* The transition is gradual from the 2 former species which belong to the sections *Echinopsilon,* Volkens and *Eriochiton,* R. H. Anderson, with "perianth remaining membranous and not at all, or very slightly hardened in the fruiting stage" (Anderson), to the 2 latter species with very hard fruiting perianths, which belong to the sections *Anisacantha,* Volkens and *Dissocarpus,* Volkens. The sections *Echinopsilon* and *Eriochiton* have practically the same perianth as the typical *Bassias* of the Mediterranean and Western Asiatic regions, and it may be remarked that Allioni, the author of the genus *Bassia,* says:—"The substance of the calyx and receptacle having become firm and *coriaceous,* forms a round flattened fruit (calycis et receptaculi substantia firma et coriacea reddita fructum rotundum efficit complanatum)." This description applies to *B. muricata,* a North African species.

It is difficult to see how *Austrobassia* and *Sclerolaena* can be maintained as separate genera. *B. decurrens, B. intricata, B. quinquecuspis,* and *B. divaricata* have all the same sort of fruiting perianth—hard but not very thick—and yet the 2 former are placed by Ulbrich in *Austrobassia* and the 2 latter in *Sclerolaena.*

Neither does the revival of the genus *Dissocarpus*—originated by F. v. Mueller, but afterwards abandoned by him as unnecessary—appear as a happy decision. If one may quote an analogy from another family, *Eucalyptus Lehmannii* has the fruiting receptacles united in a dense woody mass, just as is the case with the fruiting perianths of *Bassia paradoxa,* but I do not know that any botanist has suggested forming a new genus based on *E. Lehmannii.*

Even when the species with hardened perianths are included, *Bassia* remains a well-defined genus, and I think most Australian botanists will favour its retention for all our species.

Bassia Blackiana, Ising. 22 miles west of Oodnadatta, August 5, 1933, *J. B. Cleland.* More hairy than in the type-specimens collected by Mr. Ising, the leaves, especially the young ones, silky-villous and the perianth-tube hairy.

Atriplex paludosum, R. Br. Specimens from Cape Thevenard, collected by Prof. Cleland, show that, while the leaves are usually small and entire, some of those at the base of the flowering branches may be fully 3 cm. long, cuneate at base, acute at summit, and with 1 or 2 coarse lobes along each margin.

Salicornia Blackiana, Ulbrich in Nat. Pflanzenfam. ed. 2 : 16c : 553 (1934) in place of *S. pachystachya,* J. M. Black (1921) because that name is preoccupied by *S. pachystachya,* Bunge ex Ungern-Sternberg (1866), a species of Madagascar.

AIZOACEAE.

Sarcozona, nov. gen.

(Ex verbis graecis σαρξ, σαρκος, carnis, et ζωνη, cingulum, zona, involucrum).

Folia opposita, carnea, trigona; flores 1-3 terminales, sessiles in axillâ foliorum summorum; perianthium liberum sed vaginâ communi carneâ cyathiformi duarum bractearum foliacearum accrescentium arcte cinctum; perianthii lobi 4, erecti, duo exteriores foliacei, duo interiores minores, late scarioso-marginati; petala linearia, bi-tri-serialia; stigmata 4-5, erecta; stamina biserialia, numerosa; ovarium 4-5-loculare, placentis parietalibus; fructus ventricosus, succulentus, in vaginâ bractearum permanens, indehiscens (ut in *Carpobroto);* semina numerosa (pl. xi., fig. 2).

S. Pulleinei, nov. comb.—*Carpobrotus Pulleinei,* J. M. Black in Trans. Roy. Soc. S.A. 56 : 40 (mutatis mutandis), t. 1, fig. 3 (1932).

The new genus is rendered necessary by N. E. Brown's discovery, on specimens forwarded to him, that the outer covering of the perianth does not consist of 2 lobes, as was stated in my original description, but is really a sort of fleshy cup-shaped involucre, formed by the common sheath, or connate sheaths, of 2 small leafy bracts. This sheath embraces the perianth closely, but is quite free from it. The real perianth has therefore 4, and not 6 lobes as originally described, the 2 outer ones small, but green and leaflike, the 2 inner ones still smaller and consisting chiefly of a broad rounded scarious margin. The red petals (in the only known species) number 20 to 40, in 2-3 rows, and are about 7 mm. long in specimens from the Gawler Ranges and Emu Downs, South Australia, and 11 mm. long in those from the Barrier Range, New South Wales. The anthers and filaments are white; the ovary 4- rarely 5-celled.

Mr. Brown considers that the plant differs in so many characters from *Carpobrotus* that a new genus (so far monotypic) should be created for its reception, and I have followed his advice as that of the leading authority on the *Mesembryanthemeae*.

Another correction, kindly made by Mr. Brown in the name of one of our introduced species, is *Drosanthemum candens* (Haw.) Schwantes, instead of *Mesembryanthemum floribundum*, Haw.

The genus *Gunniopsis*, established by Pax in 1889 for species of *Aizoon* with 4 valvate perianth-lobes, is discarded by Pax and Hoffmann in the second edition of the Pflanzenfamilien (1934), and the species so named (2 in South Australia) are replaced in *Aizoon*.

Neogunnia, Pax et K. Hoffm. in Nat. Pflanzenfam. ed. 2 : 16c : 225 (1934) takes the place of the genus *Gunnia*, F. v. M. Rep. Babb. Exped. 9 (1859), because of the prior *Gunnia*, Lindl. (1834) in *Orchidaceae*. This change affects 1 South Australian species, which becomes *N. septifraga* (F. v. M.) Pax et K. Hoffm.

Cruciferae.

**Conringia orientalis* (L.) Andrz. This glabrous European weed, with whitish petals, entire oblong stem-clasping leaves and tetragonous pods 10-12 cm. long, has been collected near Hamilton, South Australia, by Worsley C. Johnston. It was recorded several years ago in North-West Victoria.—*Erysimum orientale* (L.) Miller. *Conringia*, Heist. differs from *Erysimum* in its glabrous character, whitish (not yellow) flowers and cordate-clasping stem-leaves.

Geococcus pusillus, J. Drumm. Seven miles east of Iron Knob, Eyre Peninsula, *J. B. Cleland*. A new district for this species.

Leguminosae.

Acacia dictyophleba, F. v. M. East of Camp 9, plain between Musgrave and Mann Ranges, June 29, 1933; Camp 18, 2 miles north-west of Konamata, on sandhills with poplar and tea-tree, July 16, 1933, *Tindale and Hackett*. In these specimens, as well as in others from north of Marree, Cordillo and Minnie Downs and Finke River, C.A., the phyllodes have normally only 2 longitudinal nerves, although sometimes a third one may extend from the base half way or more upwards. The species should therefore be placed next to *A. montana*, Benth., from which it differs in its usually longer phyllodes, its longer peduncles, which are solitary or 2-3 in the axil, its shorter petals, its much longer, glabrous, shining pod and its transverse seeds.

Acacia notabilis, F. v. M. Ulpara Waterhole, Mount Crombie, south-west of the Musgrave Ranges, July 19, 1933. "Seeds ground up by natives and eaten as 'Konakandi,' *i.e.*, damper," *Tindale and Hackett*. This is apparently the form with conspicuous lateral reticulate nerves on the phyllodes, raised to specific rank as *A. validinervia*, Maiden in Journ. Roy. Soc. W.A. 13 : 15 (1928),

on specimens collected by Helms in the Cavenagh Range, Western Australia, in 1891. I question whether it can even be considered a variety. Our specimens, from various parts of the State, show great diversity in the strength or faintness of the lateral nerves. The petals are never "quite glabrous," as stated by Maiden in describing his new species, nor "silky-pubescent," as stated by Bentham (Fl. Aust. 2 : 365), but are always papillose in the upper part, the papillae sometimes lengthening into a few minute hairs at the very tip.

Pultenaea tenuifolia, R. Br. Kersbrook (Mount Lofty Range), *C. M. Eardley.* Leaves linear-lanceolate, 1-1½ mm. broad, the margins not involute, but only incurved, so that the upper surface is exposed. This change from the typical terete leaf is probably due to the moister situation.

Dillwynia uncinata (Turcz.) J. M. Black. Koonibba, near Fowler's Bay, *J. B. Cleland.* A new locality, connecting with the stations of this species in Western Australia.

**Robinia pseudacacia,* L. This handsome tree, sometimes called "Locust Tree," with drooping racemes of fragrant white flowers, has established itself along creeks in gullies of the Flinders Range, below the Wirrabara Forest, as an escape.—North America.

RUTACEAE.

Boronia Edwardsii, Benth. Gravelly hilltop near Mount Scrub, Hundred of Waitpinga, *J. B. Cleland.* Dwarf rigid shrubs, 10-20 cm. high, with the leaflets pubescent above.

Phebalium brachyphyllum, Benth. Fl. Aust. 1 : 341 (1863). Specimens from Warooka, Yorke Peninsula, are in flower and show that the pedicels are 3-4 mm. long, with 2 minute bracts below the middle, the calyx about 2 mm. long, with deltoid lobes, the petals linear-lanceolate, 5-6 mm. long, pink towards the tip, the leaves minutely scabrous; stamens about as long as petals (pl. x., fig. 2).

Mueller, in 1st Cens. 11 (1882) states that this is the same plant as *Eriostemon microphyllus,* F. v. M. in Trans. Philos. Soc. Vict. 1 : 99 (1855), a fact which Bentham seems to have overlooked. Mueller gives the habitat as "on the low coast ranges of Spencer's and St. Vincent Gulfs, but only rare." Bentham's name, however, stands in the genus *Phebalium* because of *Ph. microphyllum,* Turcz. (1852), a Western Australian species.

EUPHORBIACEAE.

Amperea spartioides, Brongn. Woodside, November, 1933, per J. E. L. Machell. Hitherto only recorded for the South-East.

MALVACEAE.

Sida virgata, Hook. var. *phaeotricha* (F. v. M.) Benth. Has a different appearance from the type on account of the much denser and looser stellate golden-brown tomentum, which is specially noticeable on the calyx and the pedicel down to the articulation where the latter joins the peduncle proper; calyx 5-6 mm. long; petals 7-8 mm. long and 8 mm. broad near the notched summit.—*S. phaeotricha,* F. v. M.

Ernabella and Erliwanjawanja, Musgrave Ranges, August, 1933, *J. B. Cleland;* west of Mount Kintore (near the Deering Hills), July, 1933, *Tindale and Hackett.* The variety appears to have been found hitherto only in our North-West, but it will probably be discovered in Central and Western Australia.

STERCULIACEAE.

Brachychiton Gregorii, F. v. M. South of Mann Range, July, 1933, *Tindale and Hackett.* "On mallee and porcupine plain, each tree growing from the heart

of a mallee clump; the seeds are an important food of the natives, who call the tree 'ngalta' and 'ngaltatjiti.'"

This is the first time specimens have been collected since the Elder Expedition passed through our Far North-West in 1891. All the leaves on our specimens have only 3 long narrow lobes, and are supported on filiform petioles 3½-10 cm. long, but always shorter than the leaf; follicles coriaceous, brown, finally glabrous outside, ovoid, 2-2½ cm. long, villous inside, abruptly narrowed at base and with a sharp hooked beak at summit; seeds fallen; stipes 2-3½ cm. long. Probably the follicles are sometimes much larger, as Mueller describes those of the type, from the Murchison River, Western Australia, as 2 inches (5 cm.) long.

FRANKENIACEAE.

Frankenia uncinata, Sprague et Summerh., Minnie Downs, near Diamantina River, South Australia, August, 1931, *L. Reese*. Small greyish much-branched plant 10-15 cm. high; calyx 6-7 cm. long, with hooked hairs; the hairs on the stems and branches are usually straight; petals 9-12 mm. long, the lamina about 4 mm. broad; stigmas linear, ½-1 mm. long; leaves 3-10 mm. long, with minute or gland-like hairs, the upper leaves linear or lanceolate, with revolute margins almost concealing the under-surface, some of the lower ones becoming glabrous above, almost flat, and about 3 mm. broad. The hairs on the calyx are sometimes only slightly hooked.

These specimens contain the leading characters of *F. uncinata* and *F. hamata*, Summerh., and I think these 2 species should be united under the first name, both being of the same date. Mr. Summerhayes, in his "Revision of the Australian species of Frankenia," Journ. Linn. Soc. 48 : 382 (1930) says:—"Further research may show that *F. hamata* is only a luxuriant form of *F. uncinata*, but at present the evidence is not sufficient."

MYRTACEAE.

Melaleuca linophylla, F. v. M. Musgrave Ranges, *J. B. Cleland*. This is a "paperbark" tea-tree.

Melaleuca monticola, nov. sp. Frutex cortice rugoso nigello; ramuli foliaque juvenilia pubescentia, demum plus minusve glabrescentia; folia alterna, lineari-lanceolata, 4-10 mm. longa, circa 1½ mm. lata, acuta, sessilia, conferta, erecto-patentia, crassa, rigida subplana vel supra subconcava, glandulis translucidis immersis conspersa, 3-5-nervia; flores pauci, parvi, axillares, spicati vel fere glomerati; rhachis florifera pubescens; receptaculum cyathiforme, cinereum, parce pubescens, 2 mm. longum, sepala glabrescentia decidua aequans; petala alba, 1½ mm. diam.; fasciculi staminales 9-12-andri, circa 3 mm. longi, filamentis albis, ungui quam petalum breviore; fructus brevissime cylindratus, late truncatus, circa 2 mm. longus, 2½-3 mm. diam., apice haud vel vix angustatus (pl. x., fig. 1).

Near Ernabella, Musgrave Ranges, August, 1933, *J. B. Cleland;* Glen Ferdinand, July, 1914, *S. A. White*. A "black tea-tree," resembling *M. pubescens*, from which it differs in the sessile glandular-dotted leaves, the smaller and differently shaped flowers, and especially in the small squat fruit, broadly truncate and not or scarcely contracted at either end. The leaves of *M. pubescens* are supported on a short flat petiole, ½-1 mm. long, and have no immersed transparent glandular dots as in this species.

Calythrix tetragona, Labill. A curious form was collected by Prof. Cleland in October, 1933, along the coast between Hallett's Cove and Port Noarlunga, the long awns of the sepals being entirely absent. Technically this peculiarity would place the plant in *Lhotzkya*, but it is certainly *C. tetragona*—the form with pubescent branchlets and glabrous tetragonous leaves 4-7 mm. long.

Eucalyptus Ewartiana, Maiden. A mallee, normally with striped deciduous bark; leaves thick, stiff, pale-green, broad-lanceolate, 5-9 cm. long, 2-2½ cm. broad, the nerves inconspicuous, the intramarginal one about 1 mm. from the edge; peduncle terete, 8-20 mm. long; umbel with 3-6 flowers on pedicels 2-3 mm. long; buds clavate, with small hemispherical cap; fruit depressed-globular, 9-11 mm. long, 12-13 mm. diam., the length including the broad exserted convex rim, but not the 4, rarely 3 deltoid exserted valves tipped by linear points about 4 mm. long, which soon break off, the rim conspicuous but shorter than the receptacle; fertile seeds ovoid-truncate, light-brown, about 3½ mm. long, 3-angled and narrowly winged on each angle.

Yeelunginna Hill (west of Everard Range), June 12, 1891, *R. Helms;* plain between Musgrave and Mann Ranges, June 29, 1933; north-west of Konamata (south of Mann Range), July 15, 1933, *Tindale and Hackett.* Also in Western Australia.

Helms's specimen is the type, described by Maiden in 1919.

Very near *E. Oldfieldii,* F. v. M., from which it differs in the fruit rather smaller and shortly pedicellate instead of subsessile, and perhaps also in the long erect fragile points of the valves, after the manner of *E. oleosa* and *E. incrassata* var. *protrusa.* These linear extensions of the valves are not mentioned by Maiden, probably because in the type specimen they were all broken off, leaving only the lower deltoid parts.

Eucalyptus dichromophloia, F. v. M. Specimens collected by Messrs. Tindale and Hackett between the Mann and Musgrave Ranges, South Australia, appear to belong to this species rather than to *E. terminalis.* They have very smooth, thin-skinned, urn-shaped fruits, smaller than those of *E. terminalis.*

Eucalyptus incrassata, Labill. var. *protrusa,* J. M. Black. Mr. A. Morris, of Broken Hill, when growing seedlings of this mallee, from specimens gathered near Whyalla, Eyre Peninsula, found that the cotyledons were broad and reniform in outline. The fruits, with their protruding valve-points, are so much like those of *E. oleosa* that specimens without buds have sometimes been classed as belonging to that species. The cotyledons are, however, like those of *E. incrassata* and very different from the narrow bisected or V-shaped cotyledons of *oleosa.* The operculum is, of course, quite distinct in the 2 species.

Solanaceae.

Of the 3 species of *Nicotiana* which I have grown in the garden—*N. excelsior, N. Gossei,* and *N. ingulba*—none have survived the first year, so that they may be annual, in spite of the robust appearance of the 2 first-named. On the other hand, Mr. H. Greaves, Director of the Botanic Garden, who first grew *N. ingulba,* tells me that he finds it at least biennial.

Solanum centrale, nov sp. Frutex omnino dense stellato-tomentellus; aculei graciles, in ramis petiolisque pauci et rari, in foliis nulli, in calycibus nulli vel rarissimi; folia crassa, velutina, 3-6 cm. longa, 1½-3 cm. lata, basi rotundata, integra, obtusa, supra fulva, infra viridella; petioli 5-18 mm. longi; flores nutantes in cymis corymbiformibus, pedunculatis, lateralibus; pedicelli 5-10 mm. longi; calyx 8-9 mm. longus, lobis lanceolatis obtusis, circa 5 mm. longis, sub fructu deltoideis; corolla purpurascens, circa 20 mm. longa, extus tomentella; antherae 8-9 mm. longae; inferior pars styli stellato-pilosa; bacca ovoidea, circa 15 mm. longa, 10-12 mm. diam., flava, edulis, 4-locularis (pl. xi., fig. 4).

Central Australia—Macdonald Downs Station, 1932, *Miss J. Chalmers.* Miss Chalmers says its name in the language of the Ilaura tribe is "akitjura," and adds:—"Berries bright yellow when ripe, egg-shaped; will keep well when dried; the natives eat them dry or mashed up in water."

Differs from *S. ellipticum* in the shorter and less subulate calyx-lobes, the style hairy in the lower half, instead of glabrous, the corymb-like cymes instead of long racemes and the usually smaller ovoid (not globular) fruit.

Solanum ellipticum, R. Br. has been found in Central Australia at Macdonald Downs by Miss J. Chalmers, and at Mount Liebig and Ya Ya Creek by Professor J. B. Cleland. The leaves are sometimes greener than in our southern specimens. Messrs. Tindale and Hackett, in a note to specimens from between the Mann and Musgrave Ranges, say the name in the eastern dialect is 'djurarupa," and in the western "koilpura," adding:—"Green fruit, about 15 mm. diam., with sweet tomato-like flavour, much eaten by natives." Miss Chalmers says the name in Ilaura is "albáringa" and describes the berry as "light-green when ripe and peeled by the natives before eating." Prof. Cleland gives the name as "randa" or "ranto" in the Aranda language, and "wandji" in Luritja. He adds:—"Fruit greyish-green and eaten when ripe."

Solanum quadriloculatum, F. v. M. A rather stout undershrub, with a dense soft greyish or greenish stellate tomentum; prickles slender, pale-yellow, usually rather numerous on the stems, scattered and caducous on calyxes, none on leaves or a few small ones near base of midrib below; leaves petiolate, entire, ovate-acute, thick, soft, 5-12 cm. long, 2½-6 cm. broad; flowers in lateral racemes on stout peduncles 4-9 cm. long; pedicels recurved, 5-10 mm. long; calyx 6-8 mm. long, the lobes unequal, linear-lanceolate, lengthening in fruit; corolla purplish, about 2 cm. diam. when open; style glabrous; berry globular, yellow, 12-18 mm. diam., 4-celled, becoming very hard, inedible.—*S. ellipticum* var. *duribaccalis,* J. M. Black in Trans. Roy. Soc. S. Aust. 52 : 227 (1828).

South Australia—Mount Lyndhurst, *Max Koch* (in Tate Herb.); Finniss Springs, *F. D. Warren.* Not previously recorded in our State.

Central Australia. Rumbalara railway station, Mount Liebig and Mount Hay, *J. B. Cleland;* Macdonald Downs, *Miss J. Chalmers;* near Lander River, *G. F. Hill.* Also in North Australia.

Miss Chalmers writes that the native name is "únduk-únduk." Of the fruit she says:—"Yellow in colour, round, the size of a marble, not eaten." Prof. Cleland says:—"Berry green, then yellow, not eaten."

Var. *mollibaccalis* and var. *duribaccalis,* described as varieties of *S. ellipticum,* l.c. supra (1828), must be deleted, as they were due to a mistaken determination of Max Koch's specimen.

The hard inedible fruit resembles that of *S. petrophilum,* but the leaves of the latter are sinuate-lobed, thinner, prickly, greener on the upper face and the calyx-lobes more conspicuously keeled.

S. eremophilum, F. v. M. Additional localities for South Australia are Murnpeowie and Tarcoola; for Central Australia Haast's Bluff, *J. B. Cleland;* Macdonald Downs, *Miss J. Chalmers.* The globular berry is about 12-15 mm. diam. and is at least half-enclosed in the more or less prickly calyx. Miss Chalmers says it is called "Wild Gooseberry" by the white residents and "mónũma" by the blacks in the Ilaura language. Of the fruit she writes:—"Size of a marble; has a pleasant smell and an excellent flavour." The fruiting peduncles are 4-7 cm. long, the fruiting pedicels 2-2½ cm. long.

Scrophulariaceae.

Stemodia viscosa, Roxb. This plant, recorded hitherto only from the Birksgate Range in our State, has been found by Prof. Cleland at a rockhole 8 miles north of Ernabella, in the Musgrave Ranges.

**Zaluzianskia divaricata* (Thunb.) Walp. Palmer (near Mannum), *M. T. Winkler.* A new locality for this small South African plant.

LABIATAE.

**Ajuga Iva,* Schreb. Dry paddock at Roseworthy Agricultural College, November, 1933, *G. H. Clarke.* Mediterranean region.

RUBIACEAE.

Plectronia latifolia (F. v. M.) Benth. et Hook. Camp 16, Kanpi, south side of Mann Range, July 14, 1933, *Tindale and Hackett.* The short calyx-teeth are more often 4 than 5.

CUCURBITACEAE.

Cucumis Chate, Hasselq. (*C. Melo.* L. var. *agrestis,* Naud.) Pandi Pandi, on Diamantina River, September, 1934, *J. B. Cleland.* The fruit is eaten by the natives after the hairs have been rubbed off.

CAMPANULACEAE.

Wahlenbergia.

Mr. N. E. Brown, in the Gardener's Chronicle 54 : 316, 336 and 354 (1913) reviewed the Australian and New Zealand species of this genus and described 4 of them at length. It is certainly unsatisfactory to place plants so different in many of their characters under *W. gracilis,* A. DC., as was done by Bentham in Fl. Aust. The filaments, and probably the anthers, show divergencies in form which have taxonomic value. The anthers are very fugitive and are often difficult to find in dried specimens; the filaments, rising at the summit of the receptacle and surrounding the base of the style, consist of a linear or linear-lanceolate part of varying length which supports the anther and which is expanded towards the base into a flat 2-winged usually ciliate or fringed hyaline part.

Much critical work remains to be done, especially on living specimens, but the following is an attempt, based on N. E. Brown's valuable paper, to distinguish our South Australian species:—

A. Perennials; filaments dilated abruptly into 2 broad wings at base; sepals and corolla-lobes 5; leaves to 5 cm. long.
- B. Lower leaves to 8 mm. broad, mostly linear-oblong or oblanceolate.
  - C. Sepals longer than receptacle, very narrow; corolla 15-28 mm. long .. .. *W. vinciflora* 1
  - C. Sepals equalling receptacle; corolla 10-12 mm. long .. *W. Sieberi* 2
- B. All leaves narrow-linear; sepals slightly exceeding receptacle; corolla about 12 mm. long .. .. *W. multicaulis* 3

A. Annual; filaments gradually dilated downwards into 2 narrow wings; sepals and corolla-lobes 4-5; leaves mostly lanceolate or ovate, ½-2 cm. long .. .. *W. quadrifida* 4

1. *W. vinciflora* (Vent.) Decaisne in Rev. Hort. p. 41 (1849). Perennial, almost glabrous or with short spreading hairs near base; stems erect, 20-45 cm. high, branching dichotomously, rarely simple and 1-flowered; leaves mostly alternate and on lower half of plant, the lower ones linear-oblong, acute, glabrous or hairy, sessile, half-clasping, undulate and sometimes minutely toothed, 1-5 cm. long, 2-8 mm. broad, the uppermost leaves or bracts linear-lanceolate or narrow-linear; peduncles 3-20 cm. long; receptacle glabrous, 3½-4½ mm. long in flower, 6-10 mm. long, ovoid-oblong or obconical in fruit; sepals 5, 5-20 mm. long, narrow-linear, acute, glabrous; corolla dark- to light-blue or almost white, 15-28 mm. long, exceeding the sepals, the spreading lobes about as long as the tube; anthers much longer than filaments, which are abruptly dilated into a truncate fringed base; style pubescent in upper part.—*W. gracilis,* Benth. Fl. Aust. 4 : 137 (1869) partly; J. M. Black Fl. S.A. 546, fig. 239, A, D, C (1924);

Campanula vincaeflora, Vent. Jard. Malm. t. 12 (1803); *C. gracilis,* Bot. Mag. t. 691 non Forster.

Brighton; Mount Lofty Range; Berri; Murray Bridge; Ardrossan, Yorke Peninsula; Hamilton; Spalding; Booleroo; Yunta; Hawker; Minnie Downs (near Diamantina River); Hamilton Bore, Arkaringa Creek. Eastern States and Western Australia.

This is the handsome "Australian Bluebell," distinguished by its large flowers and comparatively long very narrow sepals.

Nov. var. **rosulata.** Folia fere omnia basilaria, 2-5 mm. lata, glabra vel pilosa, superioribus setaceis ad basin ramorum sitis; sepala 6 mm. longa.

Gladstone; Quorn.

2. *W. Sieberi,* A. DC. Monogr. Camp. 144 (1830). Perennial; stems erect or ascending, branching, 10-60 cm. long, scabrous with short hairs near base; leaves 1-5 cm. long, 1½-8 mm. broad, undulate with white cartilaginous margins, entire or distantly denticulate, usually scabrous, with short spreading hairs, the lower ones crowded towards base of stems, oblanceolate or obovate, acute or obtuse, tapering into a flat hairy petiole, the upper ones linear-lanceolate, sessile, distant, mostly glabrous; peduncles 2-8 cm. long; receptacle 3-4 mm. long, glabrous, in fruit ovoid and 6 mm. long; sepals 5, about the same length, narrow; corolla blue, 10-12 mm. long, the tube about as long as the acute lobes; anthers longer than filaments, which are abruptly dilated into a broad ciliate base; style almost glabrous, 3-lobed.

Minnie Downs; Strzelecki Creek; Finniss Springs (near Lake Eyre). New South Wales. Central Australia—Alice Springs.

3. *W. multicaulis,* Benth. in Hueg. Enum. 75 (1837). Perennial, glabrous or almost so; stems slender, erect, numerous, usually branching, rarely simple and 1-flowered, 10-40 cm. high; leaves all narrow-linear, the lower ones usually opposite, ½-5 cm. long, about 1 mm. or less broad; peduncles filiform, 2-7 cm. long; receptacle 3-4 mm. long, in fruit 5 mm. long and obconical; sepals 5, 3-5 mm. long, very narrow; corolla blue, about 12 mm. long, the acute lobes longer than the tube; anthers longer than filaments, which are abruptly dilated into a broad ciliate sometimes 3-lobed base; style 3-lobed, pubescent in upper part.

Lefevre's Peninsula; Glenelg; Myponga; Murray Lands; Overland Corner; Telowie Gorge and Hundred of Howe (Flinders Range), Koonamore; Lake Callabonna; Bordertown; Maitland, Yorke Peninsula; Bookabie, Eyre Peninsula. Eastern States. Western Australia.

4. *W. quadrifida* (R. Br.) A. DC. Monogr. Camp. 144 (1830). Annual; stems slender, erect or ascending, 4-20 cm. long, branching or simple and 1-flowered, beset with short spreading or deflexed hairs in all their length or only near base; leaves opposite or alternate, oblong, oblanceolate, ovate or obovate, 3-20 mm. long, 2-9 mm. broad, undulate with white cartilaginous margins, the lowest, or sometimes also the upper ones, scabrous with short spreading hairs, the uppermost lanceolate or linear-lanceolate; peduncles 1-8 cm. long; receptacle 2-3 mm. long, glabrous or with short spreading hairs, in fruit ovoid or almost globular, 3-5 mm. long; sepals 4-5, comparatively broad, 2 mm. long; corolla blue or white, 4-5-lobed, about 4-6 mm. long; anthers equalling or slightly shorter than filaments, which are gradually dilated downwards into 2 narrow ciliolate wings; style pubescent, 2-3-lobed.—*Campanula quadrifido,* R. Br. (1810); *W. gracilis,* Benth. partly, not of Forster; J. M. Black Fl. S.A. 546, fig. 239B (1924).

Waterfall Gully; Marino; Munno Para; Murray lands; Wellington; Spalding; Jamestown; Wirrabara, Moolooloo, Beltana, Mount Parry (Flinders Range); Ardrossan, Yorke Peninsula; Fowler's Bay; Lake Callabonna. New South Wales. The type came from near Port Jackson.

W. gracilis (Forst.) Schrader in Blumenbachia 38 (1827), A. DC. and Benth. partly, was described as *Campanula gracilis* from specimens collected by Forster in New Zealand and New Caledonia, and, according to N. E. Brown, it is doubtful whether it has been found in Australia.

Cephalostigma fluminale, nov. sp. Planta perennis omnino glabra; caules graciles, flexiles, ut videtur volubiles, 50-60 cm. longi, dichotome ramosi; folia fere nulla, superiora ad parvas bracteas pedunculos suffulcientes redacta; pedunculi 1-flori, capillares, flexiles, 3-8 cm. longi, laxissime paniculati; receptaculum floriferum 2 mm. longum, fructiferum ovoideum, 4 mm. longum; sepala 5, lanceolata, 2 mm. longa; corolla caerulea, profunde 5-lobata, circa 8 mm. longa, rotata, lobis basin versus attenuatis, tubo brevissimo; filamenta in basin latam subito dilatata; stylus ad aspectum capitatus, lobis 3 latis, brevibus; capsula apice tribus valvis dehiscens; semina oblongo-elliptica, fere plana, ½ mm. longa (pl. xi., fig. 1).

I have only one specimen, collected on the River Murray (without exact locality) in December, 1913, by Capt. S. A. White.

Cephalostigma, A. DC., differs from *Wahlenbergia* in the deeply 5-lobed and rotate corolla and in the broadly 3-lobed style. The genus inhabits Asia, tropical Africa and Brazil, and this appears to be the only known Australian species.

COMPOSITAE.

**Crepis taraxacifolia*, Thuill. Differs from *C. virens*, L. by the achenes all tapering into long beaks, the radical leaves pubescent, lyrate with broad-toothed lobes, the lower lobes small and distant, the stem-leaves smaller, few and clasping by auricles; involucre 10 mm. long and surpassed by the white pappus at maturity.

South-East, October, 1933, per A. G. Edquist. First record for South Australia, but Professor Ewart records it as common in Victoria since 1906.—Central and Southern Europe.

**Achillea Millefolium*, L. "Milfoil" or "Yarrow." This appears to be the species growing in our southern districts, and not *A. tanacetifolia*, All., as given in Fl. S.A. 605. It is sometimes almost woolly. The flowers may be white or purplish-red. The whole leaf is somewhat concave above, the segments not lying in the same plane, and being slightly curved upwards; the rhachis is not toothed.—All over Europe.

**Centaurea pratensis*, Thuill. Sevenhills, on uncultivated land around a currant-drying shed. February, 1934, *Worsley C. Johnston*.—Central Europe; not previously recorded here.

Wedelia verbesinoides (F. v. M. herb.) Benth. Fl. Aust. 3 : 538 (1866). Erect plant, 30-60 cm. high, scabrous all over with short rigid appressed tubercle-seated hairs; stems rigid, branching; leaves opposite, lanceolate, usually acute, 2-8 cm. long, 4-20 mm. broad, rigid, concave above, narrowed at both ends with 1-3 prominent distant teeth on each margin; peduncles solitary, terminal, 3-16 cm. long; involucre hemispherical, 4-5 mm. long, the bracts ovate-oblong, acute, in about 2 rows; receptacle convex, with broad boat-shaped scabrous keeled scales enclosing the flowers; ray-flowers female, 8-12, the ligules obovate-oblong, yellow, notched, 8-10 mm. long; disk-flowers bisexual, tubular, 5-toothed; style-branches surmounted by a short conical appendage; achenes 3-4 mm. long, black, compressed or subtrigonous, narrowly 2-winged, each wing excurrent upwards in a short blunt or acute appendage; pappus a minute denticulate cup or crown sometimes produced into 1 or 2 bristles (pl. x., fig. 6).—*W. Stirlingii*, Tate in Horn Exped. 3 : 188 (1896).

Mount Crombie (south-west of Musgrave Ranges), July, 1933, *Tindale and Hackett;* Ernabella (Musgrave Ranges), August, 1933, *J. B. Cleland*. Also in Central and North Australia. Not previously found in our State.

The genus *Wedelia*, Jacq. is distinguished from *Eclipta* chiefly by the broad keeled concave scales of the receptacle, while those of *Eclipta* are narrow-linear and do not enclose the flowers; the style-branches of *Wedelia* are appendaged above the stigmatic lines, while those of *Eclipta* are merely truncate.

The only important difference between *W. Stirlingii* and *W. verbesinoides* is that the heads of the latter are described by Bentham as short-peduncled. Mueller himself accepted specimens from Central Australia with long peduncles as *W. verbesinoides.*

Pterocaulon glandulosum, Benth. et Hook. var. *velutinum*, Ewart et Davies. Rockhole, 8 miles north of Ernabella, Musgrave Ranges, August 16, 1933, *J. B. Cleland.* In the single specimen collected the decurrent wings of the lower stem-leaves are entire, not toothed.—Central Australia.

Basedowia tenerrima (F. v. M.) J. M. Black. Rockhole, 8 miles north of Ernabella, Musgrave Ranges, August 16, 1933, *J. B. Cleland.* The specimens are complete and show a slender plant, 5-10 cm. high, the stem branching from base; the leaves 8-25 mm. long by 3-7 mm. broad, 1-nerved, reticulate. The sparse clothing, chiefly noticeable on the stems and the margins of the leaves, consists of rather long loose septate hairs. The heads contain only young buds.

Pluchea dentex, R. Br. Differs from *P. rubelliflora* in the leaves not decurrent in wings and with narrow distant conspicuous spreading teeth, which are 1-7 mm. long. Some of them are usually longer than the breadth of the leaf, which varies from 1-4 mm. The peduncles are longer (½-30 cm. long), the heads larger, the inner involucral bracts 5-6 mm. long and the disk-flowers 20-25 (pl. x., fig. 3).—*P. rubelliflora* var. *major,* J. M. Black, Fl. S.A. 626, not of Bentham.

Leigh's Creek, *R. Tate;* Everard and Birksgate Ranges, *R. Helms;* Ernabella (Musgrave Ranges) *J. B. Cleland.*—Central Australia; Queensland.

The true *P. rubelliflora* var. *major,* Benth. judging from authentic specimens lent by the Victorian National Herbarium, differs from the type only in the involucral bracts 6-7 mm. long, having the same comparatively broad, more or less decurrent, inconspicuously toothed leaves.

DESCRIPTION OF PLATES.

Plate X.

Fig. 1. *Melaleuca monticola:*—*A,* fruit; *B,* receptacle and sepals; *C.* petal.
Fig. 2. *Phebalium brachyphyllum:*—*D,* pistil and stamen.
Fig. 3. *Pluchea dentex:*—two leaves.
Fig. 4. *Tetraria monocarpa:*—spikelet; *E,* nut.
Fig. 5. *Tetraria capillaris:*—spikelet; *F,* two uppermost glumes with fertile flower, the sterile flower below them.
Fig. 6. *Wedelia verbesinoides:*—*G,* ray-flower; *H,* disk-flower; *I,* style; *J,* two scales of receptacle; *K,* two achenes.
Fig. 7. *Schoenus deformis:*—*L,* spikelet after the 2 supporting bracts have been removed; *M,* flexuose rhachilla; *N,* nut and hypogynous bristles.
Fig. 8. *Chenopodium pumilio:*—fruiting perianth; *O,* vertical section of fruit.
Fig. 9. *Chenopodium carinatum:*—fruiting perianth after one of Aellen's figures.
Fig. 10. *Chenopodium cristatum:*—one of the ripe perianth-segments.
Fig. 11. *Chenopodium melanocarpum:*—fruiting perianth.
Fig. 12. *Chenopodium atriplicinum:*—fruiting perianth.
Fig. 13. *Chenopodium rhadinostachyum:*—fruiting perianth.
Fig. 14. *Chenopodium plantaginellum:*—fruiting perianth.
Fig. 15. *Chenopodium simulans:*—*P,* plant, drawn from the type-specimen in the Victorian National Herbarium; *Q,* fruiting perianth.
Fig. 16. *Chenopodium myriocephalum:*—*R,* perianth-segment and fruit.
Fig. 17. *Chenopodium Blackianum:*—*S,* perianth of 3 segments; *T,* two fruits.

Plate XI.

Fig. 1. *Cephalostigma fluminale:*—*A,* receptacle, sepals and style; *B,* summit of capsule opening in 3 valves; *C,* seed; *D,* flower.

Fig. 2. *Sarcozona Pulleinei:*—*l,* lamina of 1 of the 2 involucral bracts; *p,* body of perianth, free but enclosed in the sheath; *sh,* sheath of the 2 bracts, bisected vertically; *o, o,* 2 outer lobes of perianth; *i,* one of the 2 inner lobes.

Fig. 3. *Calostemma purpureum:E,* flower spread open; *F,* fruit cut vertically, sprouting on April 20, 1932; *G,* a similar fruit, on May 6; *H,* same, on May 22; *I,* a dicotyledonous fruit on August 21; *J,* one of the same plants, on September 15, 1934, *i.e.*, nearly 2½ years old; c^1, first cotyledon; c^2, second cotyledon; c^3, third cotyledon; *st,* scar of style; *p,* scar of pedicel; *pl,* plumular leaf; *r,* radicle; *sh,* sheath of cotyledon, becoming the outer coat of the bulb; *fr,* withering fruit.

Fig. 4. *Solanum centrale:*—*K,* ovary and style; *L,* fruit; *M,* transverse section of fruit.

THE MUNYALLINA BEDS. A LATE-PROTEROZOIC FORMATION.

By D. Mawson, K.B., D.Sc., F.R.S.

[Read October 11, 1934.]

Introductory Notes.

The beds described herewith occupy a basin, elongated in a N.E.-S.W. direction, in the eastern foothills of the main Flinders Range in the latitude of Lake Frome. Reference to the physiography of the area has been published by Dr. W. G. Woolnough (1). A striking ridge line joining Mount Chambers, Nepouie Peak and Mount Jacob overlooks the Lake Frome Basin thereabouts and outlines the eastern margin of the belt. Following Dr. Woolnough's nomenclature, this feature may be distinguished as the Nepouie Rampart. Under this Rampart lies the Balcanoona Station homestead to the south and the Wooltana Station homestead to the north. Westward of the Nepouie Rampart lies a depressed region, a large portion of which is drained by the Munyallina Creek. The basin of the Munyallina Creek is occupied by the beds now to be described, hence the designation "Munyallina beds." However, the upper portion of the series extends beyond the basin of the Munyallina Creek into areas drained by the Arkaroola Creek and the Bolla Bollana Creek.

The Munyallina beds extend north-west towards the Bolla Bollana Creek, in the neighbourhood of which they contact with older sedimentary formations, partly along an unconformable junction and elsewhere, it is inferred, along a fault line. I have had scant opportunity of observing the north-western margin of the basin, and information relating thereto is still incomplete.

In the year 1910, at the time of our discovery of radium-bearing minerals of the Mount Painter belt, I penetrated to the Bolla Bollana Creek crossing the Flinders Range from the north, *via* Mount Painter. Then, when reconnoitring along a tributary on the south side of the Bolla Bollana Creek, tillite was discovered dipping to the south-east and overlying unconformably old sediments with which was noted an association of amygdaloidal, basic, volcanic rocks. The tillite was observed to form the base of a series extending towards Wooltana Station. A short note (2) was then published referring briefly to the geology of the Mount Painter region. Subsequently some of the volcanic rocks collected at that time were described. (3)

In 1924 an opportunity arose for again visiting the Flinders Range in that locality. On that occasion most of the time was spent examining the Archaeozoic rocks of the central Mount Painter belt, but in company with A. R. Alderman and R. G. Thomas a trek, with camels transporting our baggage, was made into the Flinders Range on the east side at several points in the neighbourhood of Wooltana and Paralana. One line of traverse took us north-west from Wooltana Station *via* the north side of Mount Warren Hastings to the Bolla Bollana Creek, then *via* the Radium Creek to Mount Painter. The remarkable occurrence of volcanic rocks at Wooltana was recorded in a subsequent publication (4), but the stratigraphy of the overlying sedimentary series was deemed sufficiently important to warrant further detailed investigation. In the meantime Dr. Woolnough, who had visited the Wooltana area in 1923 or 1924, published a paper (1) on the geology of the locality; at the time he was evidently not aware that I had contributed notes on the same area a few months previously.

My opportunity for further observation came in 1929, when, in company with several students, a further reconnaissance of the Wooltana area was effected. On that occasion the line of the present section was traversed in detail, but time would not allow of any extended areal work. Fortunately, along the line of section the beds appear to be little disturbed by dislocation or folding. Thus, though the observations were principally confined to a single line of traverse, it is likely that the section herewith is fairly accurately delineated. The only location in the section where it has appeared possible that a dislocation of any magnitude may exist is immediately below the Cave Hill limestone (No. 11) but Dr. Woolnough's account has no regard for such; hence the view that the section as detailed is correct gains confidence.

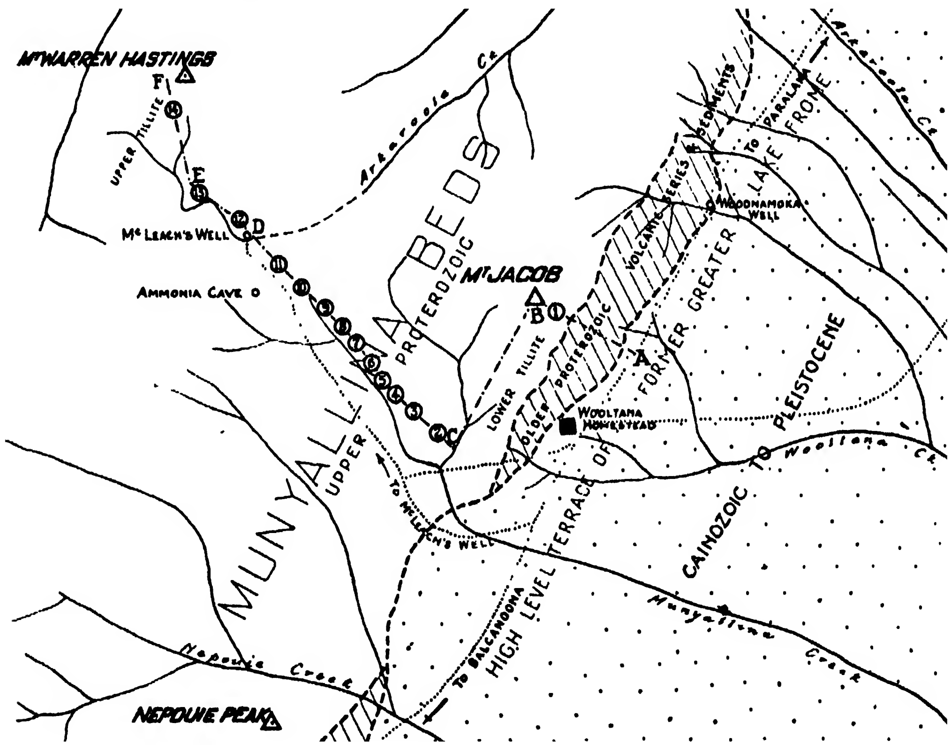

Fig. 1—Locality Map.

The dotted lines represent tracks, while the boundaries of the geological formations are shown by broken lines.

In describing the beds, they will be dealt with in certain convenient groupings, arranged in ascending sequence. The lowest beds figured underlie the lower glacial horizon, and are not included with the Munyallina beds, for the evidence seems to point to a break at the base of the glacial horizon. The question of a time break at this horizon is, however, a feature difficult to determine when judged only on the evidence presented in the escarpment at Wooltana; since, in any case, one is there faced with abnormal circumstances introduced by the onslaught of an ice age immediately superimposed upon extraordinary events arising from an outburst of volcanic activity at the very spot. Those underlying beds include a sedimentary series and volcanic contributions including ash beds, melaphyre and other basic lavas. The latter are intercalated in the sediments

immediately below the Munyallina beds. Interesting details of the occurrence are recorded by Dr. Woolnough (1). The sediments comprise not only arenaceous and argillaceous members, but also dolomites and dolomitic limestones are strongly in evidence. They doubtless correspond with some of the lower members of the Adelaide Series of the southern portions of the State.

Eastward of the Nepouie Rampart, these older beds pass under horizontally-laid Cainozoic and Pleistocene sandstone and gravel beds which constitute a high-level lake terrace of the former greater Lake Frome. These lake terrace beds also obscure the Cretaceous formations of the artesian basin which underlie the Lake Frome basin.

Descriptive Details of the Munyallina Beds.

The Munyallina beds will now be described, commencing at the base.

1. A glacial and fluvio-glacial formation. This is constituted mainly of boulder beds, most of which are definite tillites. Also included are coarse pebbly and gritty quartzites in which current bedding is well defined. Bands of finer and more even-grained quartzite have been noted.

Near the base the boulders in this series are dominantly basic lava types of the underlying formation. Also there are present quite large blocks, up to 3 ft. in diameter, of the buff-coloured dolomitic limestone of the older sediments. A couple of hundred feet above the base of the series, the boulders of limestone and of basic lavas become a minor feature owing to increasing abundance of other types, including quartzite, pink granite and quartz-porphyry. Whilst some of these beds are definitely water sorted, others are devoid of bedding and composed of pebbles with a subdued rounded and faceted form, set in a rather sandy matrix, and are obviously glacially transported and accumulated. Dr. Woolnough records (1) finding several pebbles exhibiting typical glacial striae. He also reports, in his traverse immediately west of the Wooltana homestead, meeting quartzite erratics up to 3 ft. 6 in. long and a vitreous quartz erratic as much as 9 ft. in length.

The outcrop of these beds on the steep east face of Mount Jacob attains a thickness of about 400 feet. But overlying formations of the same general character continue across the strike of a belt of country to the west of Mount Jacob, indicating a considerable additional thickness which, however, has not been definitely determined. The actual line of section which forms the subject of this paper was run from the vicinity of Mount Warren Hastings through McLeach's Well to meet the belt of Mount Jacob conglomerates at a point about 3 miles south-west by south of Mount Jacob. At that point the conglomerate series is not less than 600 feet thick and dips about 20° to the west. The average direction of strike must be approximately N.E. to S.W. (true), since this conglomerate belt is seen to be making across the country from Mount Jacob to Mount McCallum, some 9 miles to the S.W. Directions of strike actually measured in the traverse of the section ranged between N. 45° E. true near the base at Mount Jacob to only N. 5° E. locally recorded in some of the upper sections.

The upper beds of this basal boulder series at the point on the line of section, where they are overlain by fine laminated slates, contain boulders up to 4 ft. in length. Quartzites predominate, but porphyritic andesitic and acid igneous rocks as well as large blocks of scoriaceous forms of basic lavas also appear. The total thickness of this division may be taken tentatively as 1,000 ft., it is certainly not less than 600 ft. and, on the other hand, may possibly exceed 1,000 ft.

2. Next in order above the glacial and fluvio-glacial conglomerates comes a thick series of laminated slate extending across about a half-mile of outcrop.

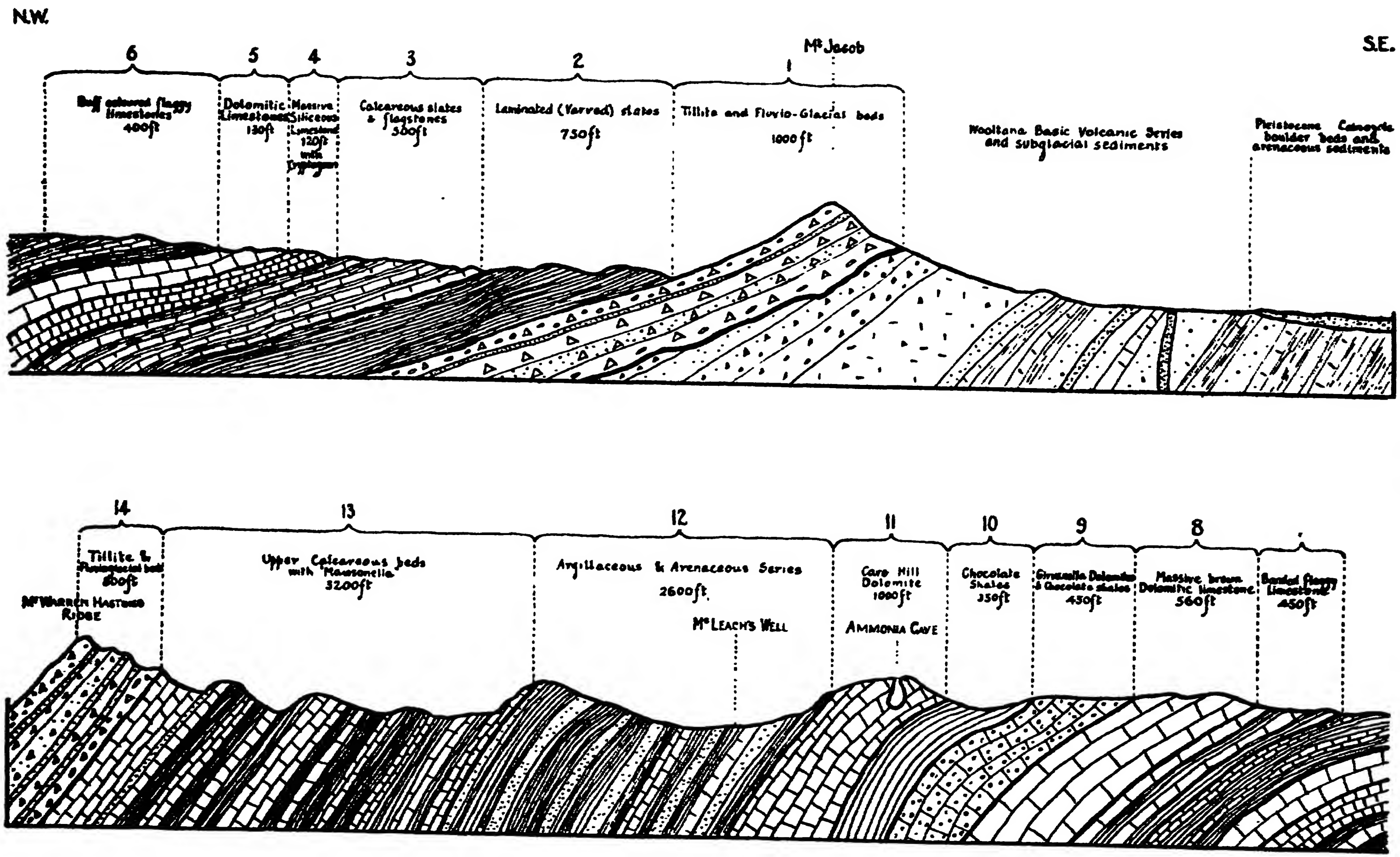

Fig. 2. Cross section of the Munyallina Beds on the line of section A B C D E F (Fig. 1).
The true thickness of each of the beds is stated.

The dip averages about 17° to the north-west. The true thickness is estimated at about 750 feet. Much of the outcrop exhibits a grey-green colour. The rock is of a rather soft nature and but little modified by recrystallization. There is evidence of a gradually increasing content of lime as one passes from the lower to the upper horizons. Cleavage ordinarily takes place along the bedding. The laminations, which are coarse in the lower portions of the beds, become very fine and poorly marked at the upper limit. Towards the base sandy bands are a feature, the character being that of a varved lamination. The sandy bands of the latter usually range between ¼ and ½ inch in thickness, but a thickness as much as 4 inches was recorded. A large part of the series resembles Tapley's Hill slate of the neighbourhood of Adelaide.

On some of the bedding planes curious markings are to be observed. These may be fucoid trails or impressions of gelatinous organisms, or of inorganic origin.

3. Calcareous slates below leading upward to flaggy limestones with vermiculate structure. The average dip may be taken as about 15 degrees and the total thickness of the section about 500 feet.

The lower 130 feet consists of slates with thin calcareous bands exhibiting vermiculate structure. Then comes 220 feet of definite limestone bands, alternating with sandy shales leading upwards to a sandy, flaggy limestone. Finally the upper 150 feet is composed of a flaggy limestone with vermiculate markings, best illustrated in the topmost beds.

Intersecting the beds of this division is a reef 4 feet wide, composed at the outcrop of quartz and iron oxide; below the weathered zone this is doubtless a pyritic quartz reef.

4. Massive siliceous limestone pervaded throughout by traceries suggesting indistinct fossil markings. Near the top some patches less affected by recrystallization exhibit distinct cryptozoön structure of the Collenia type, first met with in Australian strata by Dr. C. Chewings (5). The dip is to the N.W. and amounts to only 10 or 12 degrees. The true thickness of this limestone is reckoned at about 120 feet.

5. Calcareous strata dipping about 10 degrees to the N.W. Much of this is a yellow dolomitic limestone, on the weathered face of which some queer but indefinite markings can be traced. Total thickness, about 130 feet.

6. A flaggy limestone series of a buff colour with an average dip of about 15 degrees. The total thickness is about 400 feet. Strike, about N. 41° E. true.

7. Banded flaggy limestones of a total thickness of about 450 feet. The dip is to the west, averaging about 23 degrees. In its lower portion it is a flaggy limestone with occasional bands of calcareous sandstone up to 12 inches wide. Towards the upper limit the limestone bands alternate with slate bands. Rising in the series, a chocolate colour becomes more and more marked, both in the limestone and in the argillaceous bands. The beds are notably jointed. Ripple marks appear and miniature current bedding is to be observed. On the weathered surfaces of the limestone queer, indefinite markings are frequently exhibited.

8. Massive chocolate to brownish-coloured limestone in which oolitic structure is abundantly developed. The dip is about 20 degrees to the west and the total thickness is about 560 feet. Most of this limestone is pervaded with a faint and indefinite pattern like that of the lower limestone of section (4) described above. The upper 100 feet is a hard, coarse, siliceous brown limestone.

9. Girvanella-bearing dolomitic limestones with some chocolate shale bands. The dip is to the west at about 20 degrees, and the total thickness some 450 feet.

The lower beds for about 100 feet in thickness are yellow, coarsely oolitic, dolomitic limestones with alternating chocolate shale bands. At the top of this section the spheroidal structures are developed to a truly remarkable degree, where each spherule attains a diameter of half an inch. In microscope section they exhibit typical Girvanella structure.

Further up, in the same division, the calcareous formations become nearly exclusively developed, resulting in a more massive, dolomitic limestone formation. In this, diminutive cryptozoön forms are notable in places. Another remarkable feature which appears in certain bands in this horizon is what was entered in the field notes under the descriptive term "bacon and egg structure." The latter refers to jumbled aggregates of coarse Girvanella spheroids associated with stromatoliths developed in curvilinear strips. The topmost limestone of this section exhibits still another kind of marking of intricate structure recorded in field notes as "brain structure."

10. Chocolate shales. These follow the Girvanella horizon. Where traversed the lower beds dip at about 20 degrees, but flatten out at the upper limit under the Cave Hill dolomitic limestone. Accordingly an estimate of the thickness is rendered more difficult. After due consideration of the data recorded, a thickness of 350 feet is assigned to these beds. They are not severely indurated and tend to cleave along the bedding planes.

11. Massive dolomitic marble with no obvious fossil markings. The dip throughout most of this belt is difficult to ascertain; consequently its thickness could not be accurately estimated. The average dip appears to be about 40 degrees, still directed down to the N.W. On this basis the thickness is in the neighbourhood of 1,000 feet.

It is in this formation that the "ammonia cave" is situated. There, in a deep cave eroded in the dolomite, is an extensive deposit, largely granular gypsum, but moderately rich in ammonium sulphate and chloride. This material, which is genetically connected with accumulations of bat guano, has been exploited commercially as a fertilizer (7).

12. Next comes a belt composed dominantly of arenaceous and argillaceous beds measuring in all about 2,700 feet in thickness. The dip is fairly uniformly to the N.W. at an average angle of about 40 degrees. The lower third consists of sandy and slaty beds with some minor limestone bands. The upper section is chiefly constituted of grey slates alternating with sand rocks of which much is a gritty quartzite. McLeach's Well, where potable water can be got, is situated in a dry creek bed at about one-third of the way west across this outcrop.

At about a quarter of a mile west of McLeach's Well some unexplained markings appear in the slates. At first sight, as seen on the cleavage faces, they recall graptolite markings, but on further inspection are seen to penetrate the body of the stone and may be of inorganic origin; consequently they remain problematical. Ripple marks and other features suggest shallow water deposition for at least a part of these beds.

13. About 3,200 feet of an upper calcareous series with "Mawsonella." The dip of this section averages about 40 degrees. The lower 600 feet is a belt in which there is an alternation of argillaceous bands and calcareous bands each ranging from a few inches to a few feet in thickness. The limestones are loaded with small, light-coloured particles which, from an investigation of some loose blocks picked up by me in the creek at McLeach's Well when on the 1924 visit, have been described by F. Chapman (6) as fragments of a calcareous alga and named Mawsonella. In some of the beds the Mawsonella appears as quite large pellets, becoming in some bands so coarse as to resemble in mass an inter-

formational limestone conglomerate. In any particular band the Mawsonella particles are usually roughly of equal size. In this same belt much black chert in nodular and banded form is distributed through the limestone.

Next in order, ascending in the series, comes a belt of slate in which are cavities formerly occupied by crystals of cuboidal or octahedral form. Only cavities remain in the specimen collected; thus the nature of the original mineral is doubtful. What may be expansion cracks run out into the slate from the corners of the crystal moulds. This slate band being harder than the limestones, tends to form a moderately pronounced ridge line in the local topography.

Next overlying is a very thick series of bluish-grey Mawsonella limestone alternating with slate bands. Then comes a 10-ft. band of quartzite. Finally there is a formation about 850 feet thick, principally composed of massive grey limestone with phyllitic bands.

14. An upper glacial and fluvio-glacial series. This striking glacial series follows upon the upper limestone belt without a stratigraphical break. The dip is still steep, about 45 degrees.

When I crossed the horizon in 1924, on the trek from McLeach's Well to Mount Painter, time did not permit of our recording detailed measurements. It was noted merely that we crossed massive glacial conglomerate beds before descending a steep slope leading to a tributary stream of the Bolla Bollana Creek. In 1929 two student members of the party, J. O. G. Glastonbury and F. J. Semmens, were detailed to traverse the beds west of the Mawsonella limestones as far as the Mount Warren Hastings ridge. Their observations are included herein.

Unfortunatly, circumstances did not permit of carrying the detailed section further west than Mount Warren Hastings. Consequently the full thickness of these glacial beds is unknown. The knowledge of the beds obtained in 1924 suggests that the thickness recorded herein is likely to comprise almost the entire formation.

An account of the lower 800 feet, of which we have detailed information, is as follows, commencing at the base.

First a quartzite band about 10 feet thick immediately overlies the beds of section (13). There is no obvious unconformity. Then follows 85 feet of conglomerate with boulders of limestone and quartzite in roughly equal abundance. The boulders were noted up to 12 inches in diameter and are set in a quartzose arenaceous base. So far as noted, the limestone pebbles do not include examples with the Mawsonella markings.

Another band of quartzite about 43 feet thick follows, in turn passing upwards into a bed of conglomerate about 145 feet thick. In this the boulders, which were again observed up to 12 inches in diameter, are principally of quartzite, the limestones being of small size and less abundant.

Then comes another quartzite band about 15 feet thick, followed immediately by conglomerate about 175 feet thick, in which the pebbles attain much the same size as in the lower beds, but in which limestones are very rare.

The preceding fluvio-glacial beds then pass upwards into a definite tillite about 175 feet thick. The general colour of the rock is light grey and it has a rather slaty base. The boulders observed were mostly quartzite, but exhibited a greater diversity than that of the lower beds, including some examples that were taken to be partly decomposed basic lavas. Two striated quartzite boulders were recovered.

A strong belt of quartzite about 25 feet thick next succeeds, and is crowned by at least 140 feet of tillite, which brings the section to the alignment of Mount Warren Hastings. It is not, however, certain that the summit reached in this section is actually that named Mount Warren Hastings by the Survey Department. If not, it is one of the adjacent high points in the same belt. The country falls away further to the north-west, indicating either a waning of the resistant glacial conglomerates in the overlying strata or a cut-out by faulting. This last band of tillite at the summit has a base somewhat softer and more yellow in colour than the underlying tillites. The most remarkable feature is the great size of the boulders, some of which measured 6 feet across. The erratics are mainly quartzites, but one of the largest and most notable recorded was seen to be itself constituted of tillite. This may have been derived from lower horizons in the same series or from a still older tillite horizon of which we have evidence, to be published in due course.

General Remarks.

Evidence of a Time Break below the Lower Glacial Horizon.

The disturbed conditions arising from the initiation of volcanic activity and the inauguration of an ice age at this stage render it impossible, without a more exhaustive examination than has yet been made, to gauge to what extent, if any, a time break is represented at the base of the lower glacial horizon. There is, however, a lot of general evidence which seems to warrant such a conclusion, though the interval may not be great.

First of all, in travelling over the underlying beds between Wooltana homestead and Hart's Creek, some 10 miles to the north, they are seen to be more steeply tilted, more broken, more irregular and more indurated than the Munyallina beds. Next, basic igneous lavas and dykes with associated copper deposits are abundantly associated with them, but in the Munyallina beds nothing of the kind has yet been recorded. Again boulders of the underlying sediments and volcanic rocks are richly distributed through the glacial and fluvio-glacial strata of the Munyallina beds. Even boulders of a quartzite which appears to be identical with the basal quartzite of the underlying series are commonly met with in the Munyallina tillites.

In the year 1910, when in the rough country adjoining the Bolla Bollana Creek, I came across amygdaloidal basic lavas included in a sedimentary series capped unconformably by a tillite, which can scarcely be other than one of the Munyallina tillites.

Climatic Record.

This feature is quite remarkable, for great extremes are indicated. Dr. Woolnough has quoted evidences of aridity in the red colour and presence of suncracks in some of the beds; also in certain other lithological features of the sediments. The rich development of dolomites, and also the queer crystal moulds in some of the slate beds above the cave dolomite, point to the same conclusion.

Glacial conditions were not confined to one period, but recurred after what must have been a very long interval. This record of recurrence of glacial conditions in South Australian Proterozoic strata is not unique, for as long ago as 1906 I found in the north-east of the State evidences of recurrences of glacial conditions. Dr. R. L. Jack has recorded (8) a similar feature at Mount Grainger.

The Fossil Record.

The forms so far distinguished are all referable to calcareous algae. A curious feature of the upper limestones has been so referred by Mr. F. Chapman under the title of Mawsonella. What has thus far been recorded as Cryptozoön

in Central Australian and South Australian records, but which should perhaps be more correctly referred to Walcott's Collenia, is now recorded in the lower limestones of these beds. Oolitic structure is a feature of almost all the lower dolomitic limestones of the series; in the upper limit of this group of limestones it assumes a remarkable development in which the characteristic structure of Girvanella is wonderfully preserved. Other curious markings in the limestones may eventually be found to be referable to an organic origin.

Chronological Considerations.

I have located in the Mount Painter region two sedimentary series still older than the Munyallina beds and, in addition, a vastly more ancient crystalline terrain. Likewise I have established the existence, near Italowie Gorge, of unconformably overlying sediments in which archaeocyathus figures. No vestige of archaeocyathus has been found in the Munyallina beds. The inference, therefore, is that the beds are pre-Cambrian and, apparently, of late-Proterozoic age. The tillite horizons correlate them with the upper Adelaide Series. The oolitic character of the lower limestones and the overlying red beds suggest correlation of those limestones with the Brighton horizon of the Adelaide Series. But the cave dolomite and succeeding strata of the Munyallina beds appear to relate to a time of deposition post-dating the Brighton limestones and thus to have no counterpart in the Adelaide Series.

The oolitic and Collenia-bearing dolomitic limestones with associated red beds are probably referable to corresponding features of the Pertatataka Series of the McDonnell Ranges.

Recently, near Eurelia, some 163 miles south of Wooltana, I have met this same fossil assemblage strikingly developed. Girvanella in association with Collenia in limestones occupying a corresponding relation to a Proterozoic tillite horizon as that herein described. This limestone of the Eurelia locality has already on other considerations been regarded as corresponding with the Brighton limestone of the type area.

Summary.

The Munyallina beds appear to represent a continuous series estimated to total about 12,400 feet in thickness.

Interesting occurrences of what are regarded as calcareous algae—Girvanella, Collenia and Mawsonella—are met with in these sediments.

The climatic record is remarkable, ranging from severe glacial to probably warm arid conditions, and again glacial within the period of deposition of these beds.

A late-Proterozoic age is assigned to them. Correlation of portion of the series with the upper members of the Adelaide Series, including the Sturtian Tillite, is indicated. It would appear that these beds present a much more extended story of sedimentation during late Adelaidean times than is presented in the records of the Mount Lofty Ranges.

There seems to be no equivalent in the Adelaide region of members of the series above the chocolate shales underlying the cave dolomite.

There seems to be sufficient reason for adopting a time break below the basal glacial series of the Munyallina beds.

The underlying sediments are older-Proterozoic beds and should be equivalent of some portion of the lower Adelaide Series.

Bibliography.

1. "The Geology of the Flinders Range, South Australia, in the Neighbourhood of Wooltana Station," by Dr. W. G. Woolnough: Proc. Roy. Soc. N.S.W., vol. lx., p. 283. (Read Dec. 1, 1926.)
2. "Pre-Cambrian Areas in the North-Eastern Portion of South Australia and the Barrier, N.S.W.," by D. Mawson: A.A.A.S. Repts., vol. xiii., 1912, p. 188.
3. "Igneous Rocks of the Mount Painter Belt," by D. Mawson: Proc. Roy. Soc. S. Aust., vol. xlvii. (1923), p. 376.
4. "The Wooltana Basic Igneous Belt," by D. Mawson: Proc. Roy. Soc. S. Aust., vol. l., p. 192. (Read Aug. 6, 1926.)
5. "Notes on the Stratigraphy of Central Australia," by Dr. C. Chewings: Trans. Roy. Soc. S. Aust., vol. xxxviii. (1914), p. 51.
6. "On a New Genus of Calcareous Algae from the Lower Cambrian (?) West of Wooltana, South Australia," by F. Chapman: Proc. Roy. Soc. S. Aust., vol. li., p. 123.
7. "Report on the Occurrence of Natural Ammonium Sulphate and Chloride, associated with Guano in a cave deposit near Wooltana Head Station," by L. J. Winton, Chief Inspector of Mines: Mining Review No. 40, Dept. of Mines, S. Aust., 1924.
8. "The Mount Grainger Goldfield," by R. L. Jack, Assistant Government Geologist: Dept. of Mines, S. Aust., Report No. 2 (1913).

CLIMATE IN RELATION TO INSECT ECOLOGY IN AUSTRALIA.

1. MEAN MONTHLY PRECIPITATION AND ATMOSPHERIC SATURATION DEFICIT IN AUSTRALIA.

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[Read October 11, 1934.]

During the past few years considerable attention has been focussed on the relation of particular elements of climate and weather to the ecology of insects. There has been also a marked increase in experimental work dealing with the physiological responses of insects to the physical factors of their environment.

Certain meteorological data are used by workers investigating the geographical distribution and fluctuations in numbers of particular insects, with a view to correlating changes in the physical environment and biological responses of the species.

The methods for recording the usual meteorological data relating to weather were primarily designed with the object of accumulating precise knowledge bearing on the science of meteorology. Such data may not afford a true record of the sequence of changes occurring in the environment of particular species of insects. The micro-climate in a local situation, however, will be influenced by weather changes in the area; there will be a lag period which will vary with the degree of change and the character of the local situation.

A further consideration with respect to the use of meteorological data in ecological studies is the value which may be assigned to the mean of a series of records; with temperature and moisture (humidity) for instance, the nature of the fluctuations about the mean are particularly important. It is necessary to analyse the data with respect to specific investigations.

The monthly distribution in Australia of the important elements of climate governing the moisture available for animals and plants are shown in the twelve charts presented with this paper. The charts have been constructed from the latest data available.(1) Additional data have been obtained, as required, through the kindness of Mr. W. S. Watt, Commonwealth Meteorologist, and Mr. E. Bromley, Government Meteorologist of South Australia. I am grateful to these officers for their generous assistance in these matters.

Rainfall.

The charts show the average distribution of rain over Australia month by month. The areas have been defined so as to include increasing values of 1" of rain; with areas of heavy rainfall, however, it was necessary to adopt a wider grouping of values in order to avoid the introduction of too many shaded areas. There are no recording stations over a large portion of the west central region of Australia; the hatching lines have been broken over this region.

The charts demonstrate three of the main features of rainfall in Australia:—(1) the seasonal incidence of summer rain in the northern and north-eastern portions of the Continent; and the seasonal incidence of winter rain over the southern portion of the Continent; (2) the concentration of rainfall in the coastal regions together with a progressive decrease in the amount of precipitation with increased distance from the coast; (3) the concentration of relatively heavy rain-

(1) Meteorological data for certain Australian localities. Pamphlet No. 42, C.S.I.R. (1933).

fall along the Queensland coast and the low rainfall area over the centre of the Continent, extending to the west coast, under the influence of the trade winds.

Various aspects of rainfall in Australia have been studied by a number of workers, notably by H. A. Hunt and Griffith Taylor. More recently, the seasonal incidence, concentration and reliability of rainfall have been discussed by J. Andrews (Proc. Linn. Soc. N.S.W., 1932 and 1933).

From the point of view of the ecology of insects, rainfall primarily determines the degree of moisture available at the soil surface and in the soil; it also influences the humidity of the air. Apart from these considerations, it affects the character of the vegetation and soil type in an area, which in themselves are major ecological factors.

Atmospheric Saturation Deficit.

The amount of water vapour in the air is generally recorded in terms of relative humidity, expressed as a percentage of the saturation value of air at the given temperature. Where the air temperature is known, the percentage relative humidity can be readily converted into a water vapour pressure value. The difference between the actual recorded vapour pressure of air and the vapour pressure value of saturated air at the same temperature is termed the "saturation deficit."

The latter is a function of the temperature and relative humidity of the air and can be calculated for stations where both data are available. From an ecological point of view it is preferable to consider atmospheric humidity in terms of saturation deficiency. The latter is the major factor influencing loss of moisture by evaporation. It has an important influence on the effectiveness of precipitation in relation to moisture in the environment of insects, particularly that of the soil and the soil surface.

The isopleths given on the charts show the distribution of mean values for the saturation deficit of the air month by month. Values for each station were calculated from the mean daily temperature for the month $\left(\frac{\text{max.} + \text{min.}}{2}\right)$ and the mean relative humidity.

The Australian meteorological service has selected the 9 a.m. reading for relative humidity as representative of the mean for the day. Prescott (1934, p. 55) has shown, from examination of records at the Waite Institute, that the mean of the 9 a.m. readings gives a satisfactory value for the purpose of calculating saturation deficit.

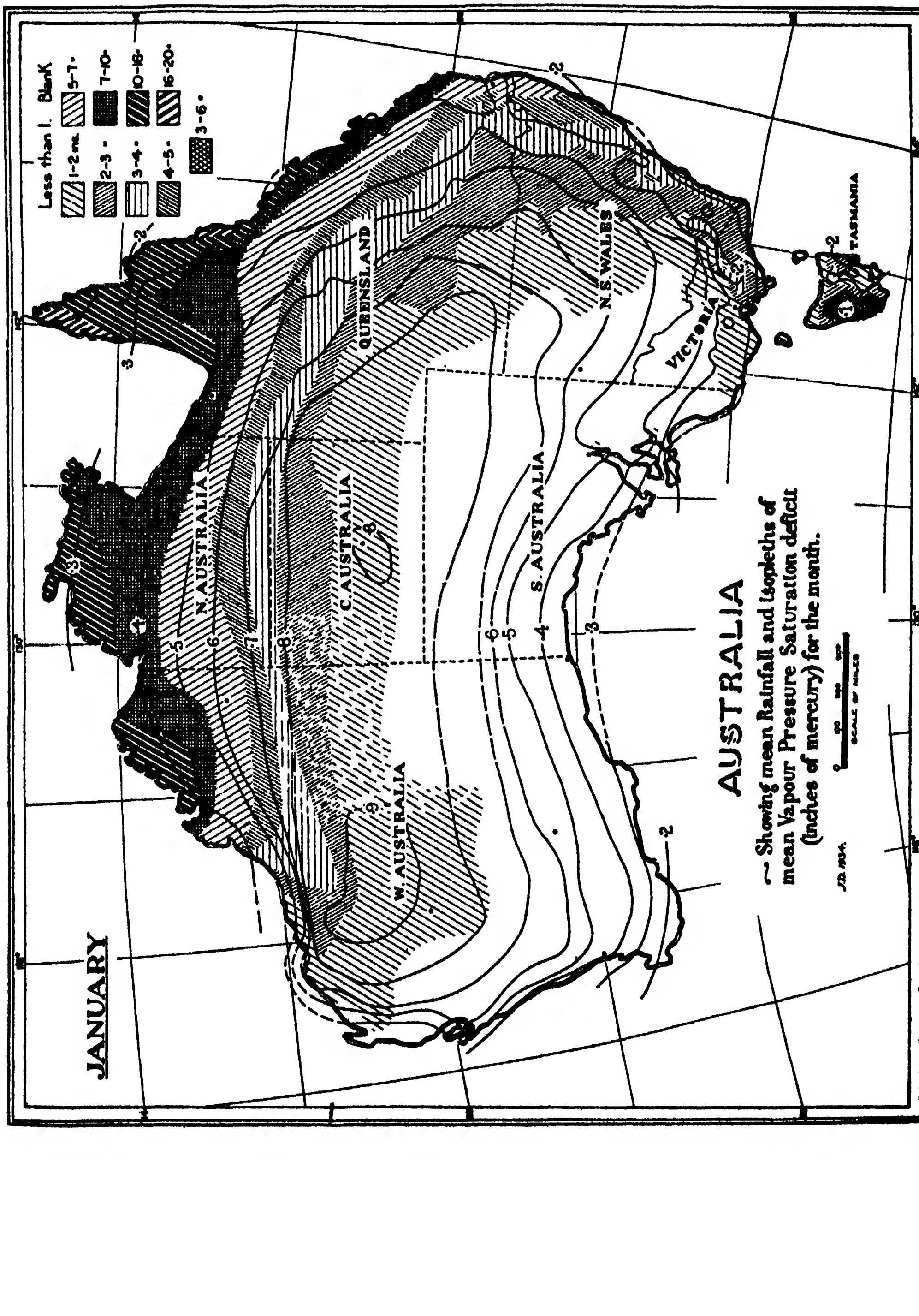
By reference to the values for saturation deficit and rainfall represented on the charts, a general picture may be obtained of the degree of dryness and wetness in any area of the Continent, month by month. Where values for saturation deficit can be expressed in terms of evaporation from a free water surface, the conditions may be more clearly defined. By this means the ratio of average rainfall to evaporation is obtained for the month; this ratio affords a useful index to the degree of dryness or wetness in the area. This subject has been dealt with in earlier papers (Davidson, 1933, 1934); it will be discussed further in the second part of the present paper.

References.

Davidson, J. 1933—The distribution of Sminthurus viridis L. (Collembola) in South Australia based on rainfall, evaporation and temperature. Australian Journ. Exp. Biol. and Med. Sc. 11 : 59-66.

Davidson, J. 1934—The monthly precipitation-evaporation ratio in Australia as determined by saturation deficit. Trans. Roy. Soc. S. Aust., 58, pp. 33-36.

Prescott, J. A. 1934—Single climatic factors. Trans. Roy. Soc. S. Aust., 58, pp. 48-61.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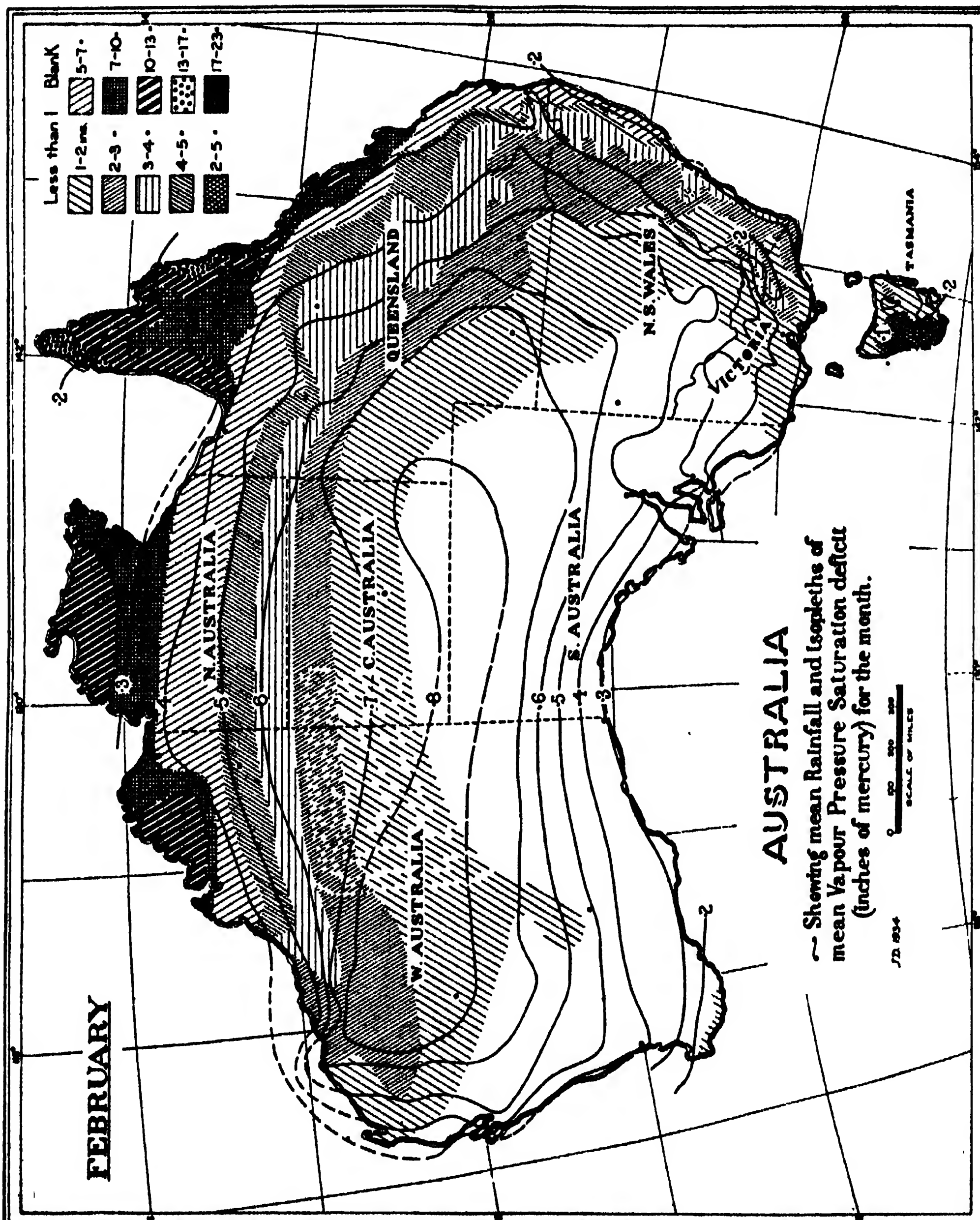
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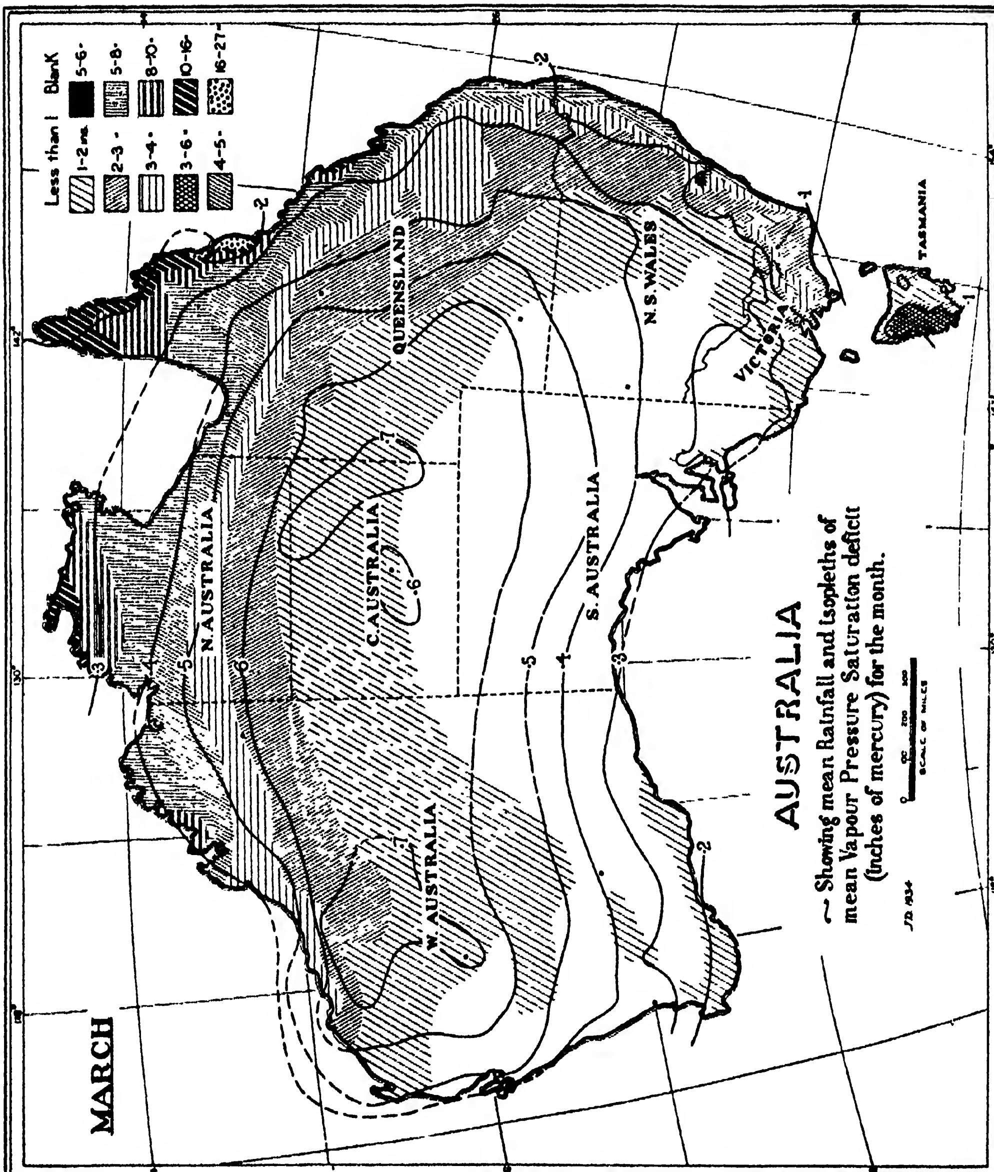
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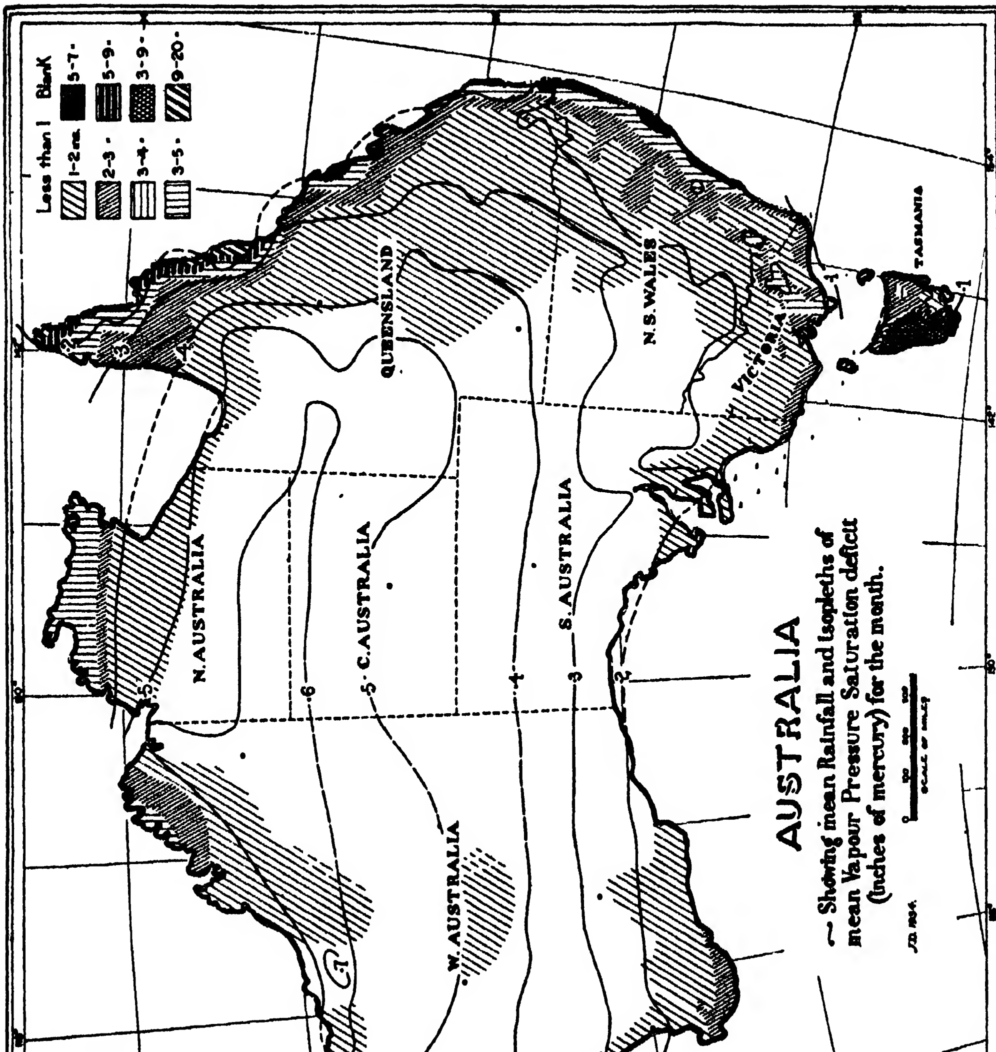
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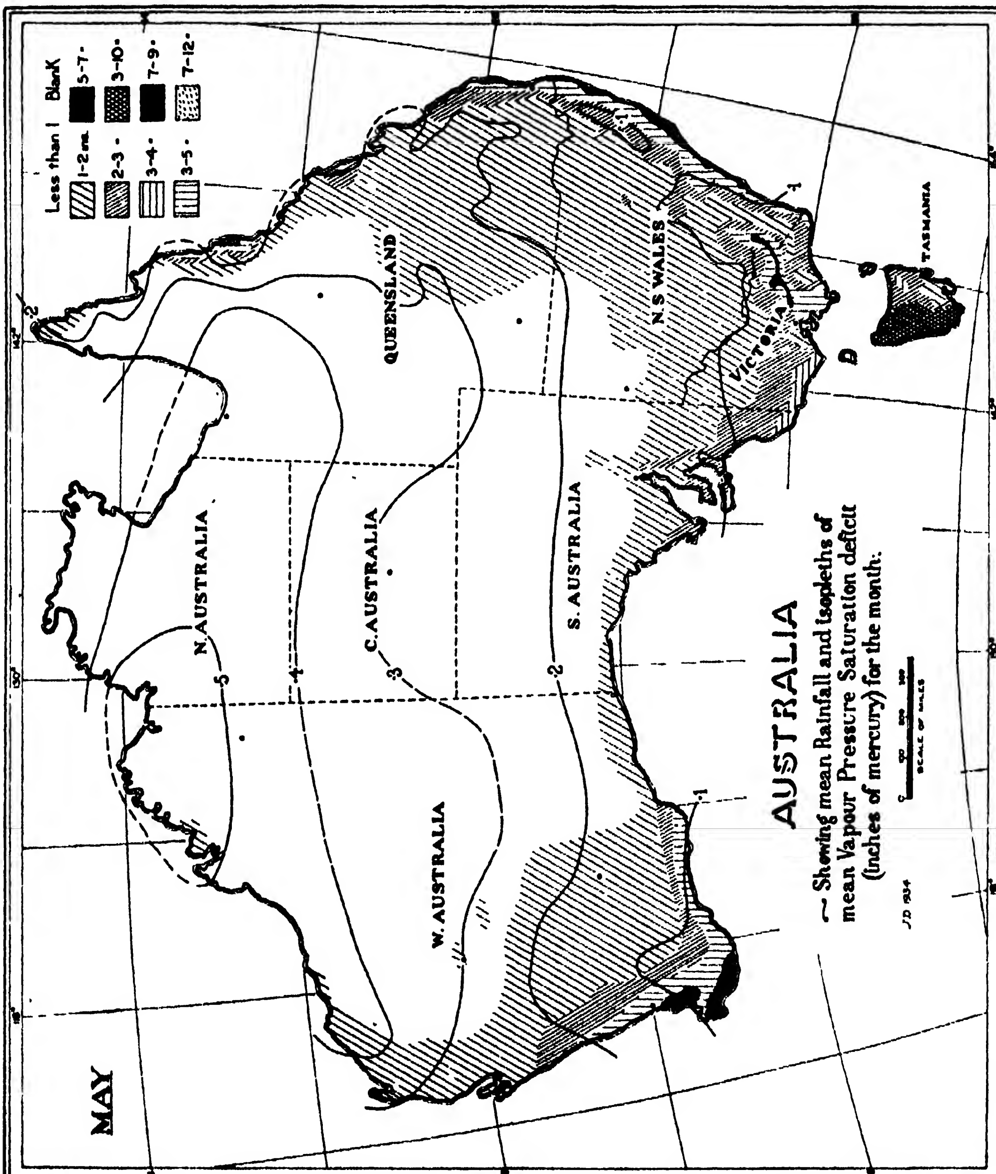

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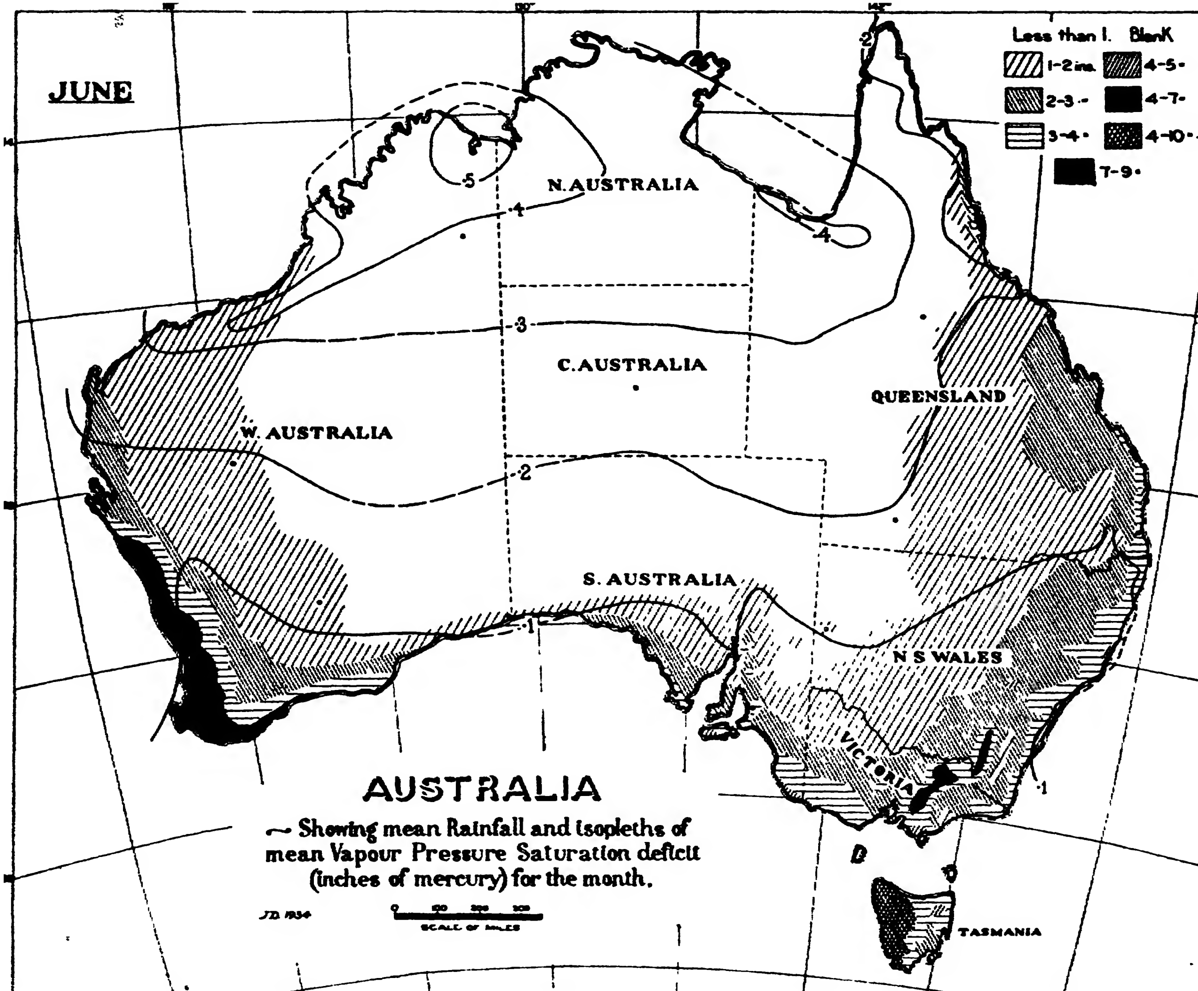

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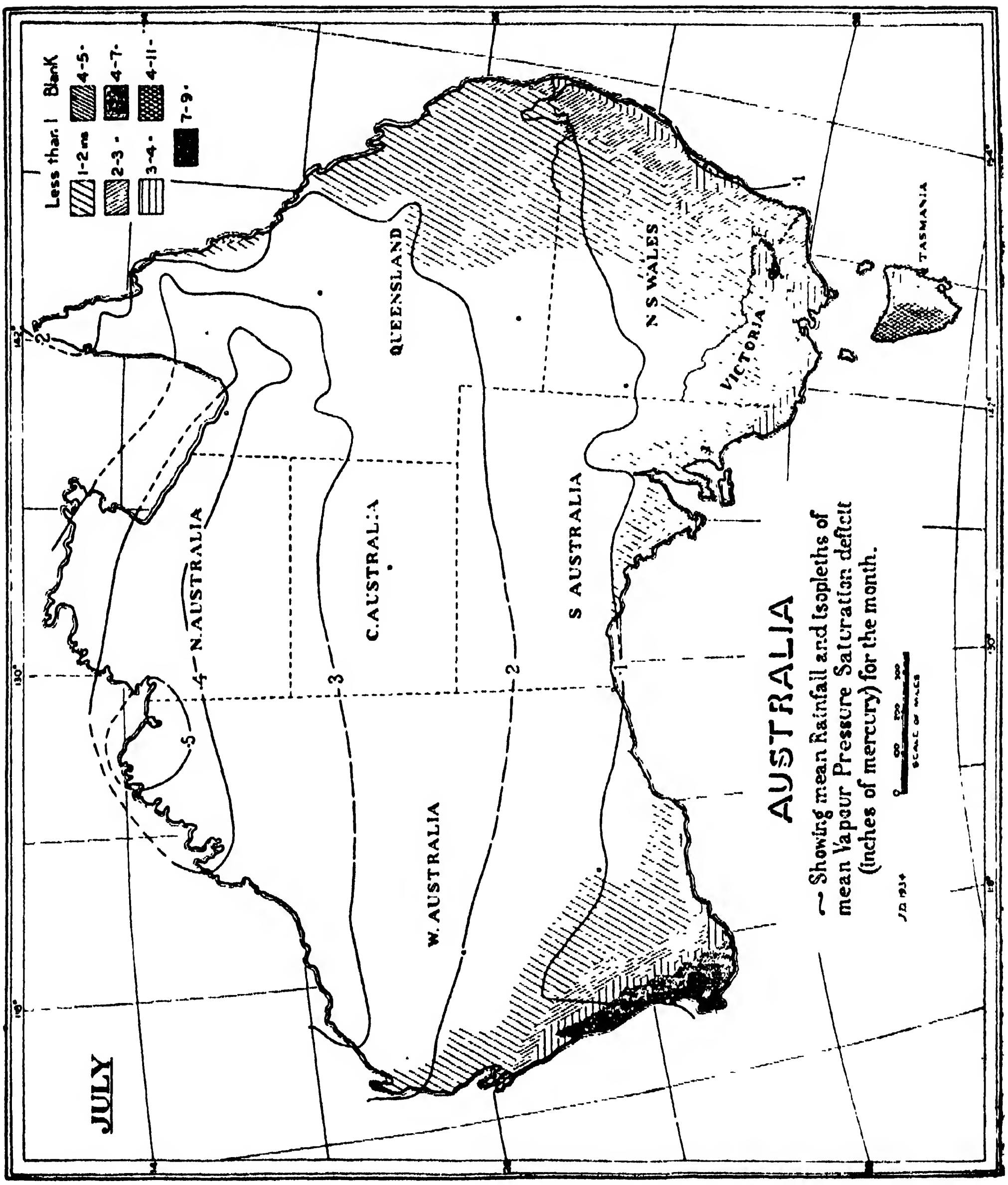

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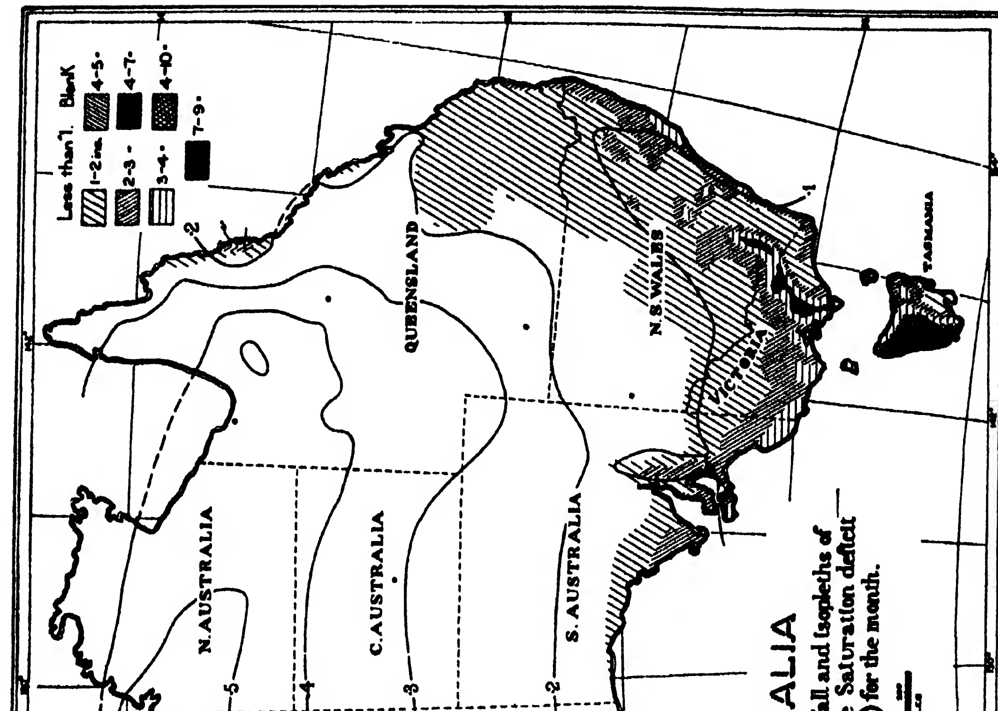
— Showing mean Rainfall and Isopleths of mean Vapour Pressure Saturation deficit (inches of mercury) for the month.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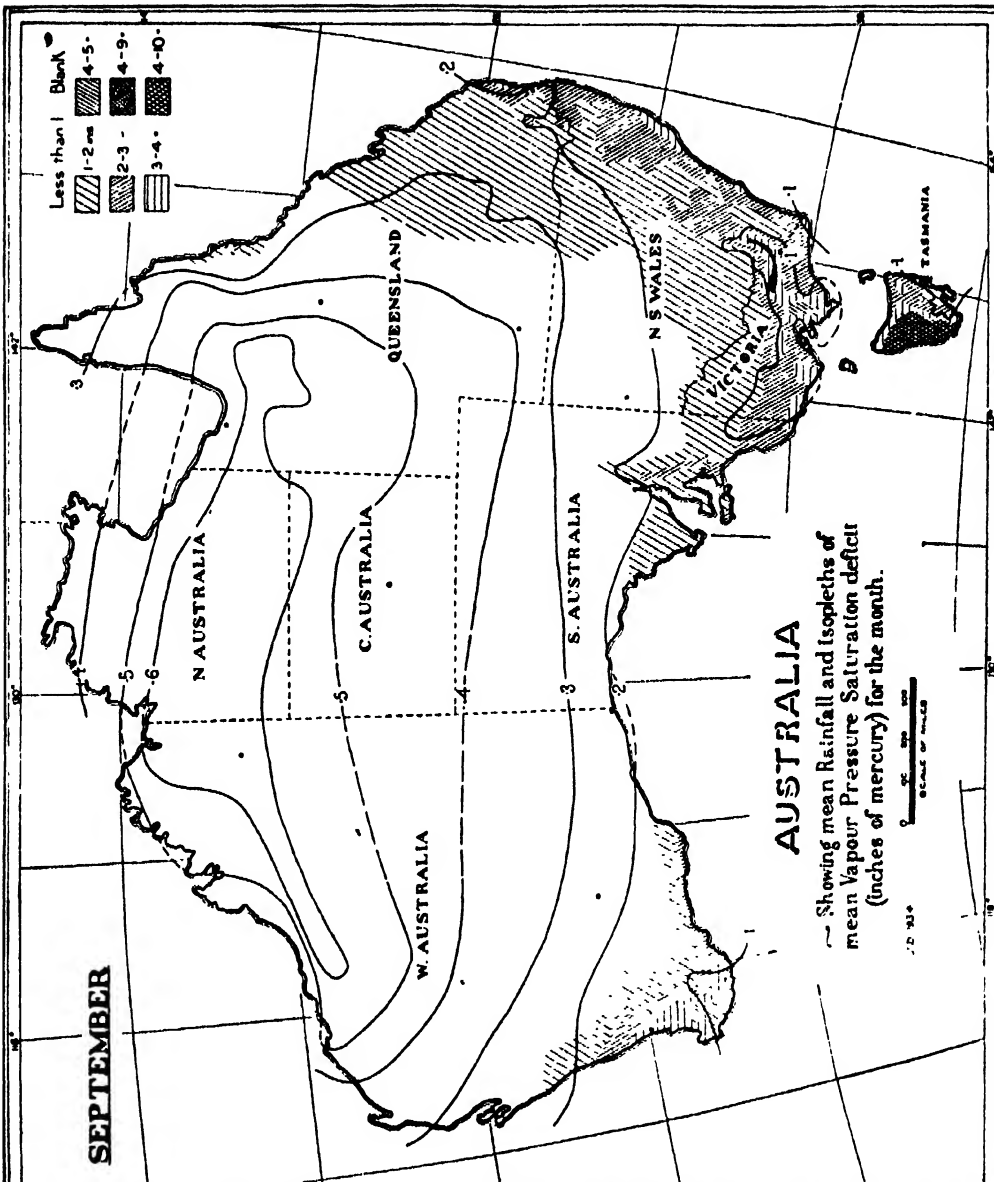
Showing mean Rainfall and Isopleths of mean Vapour Pressure Saturation deficit (inches of mercury) for the month.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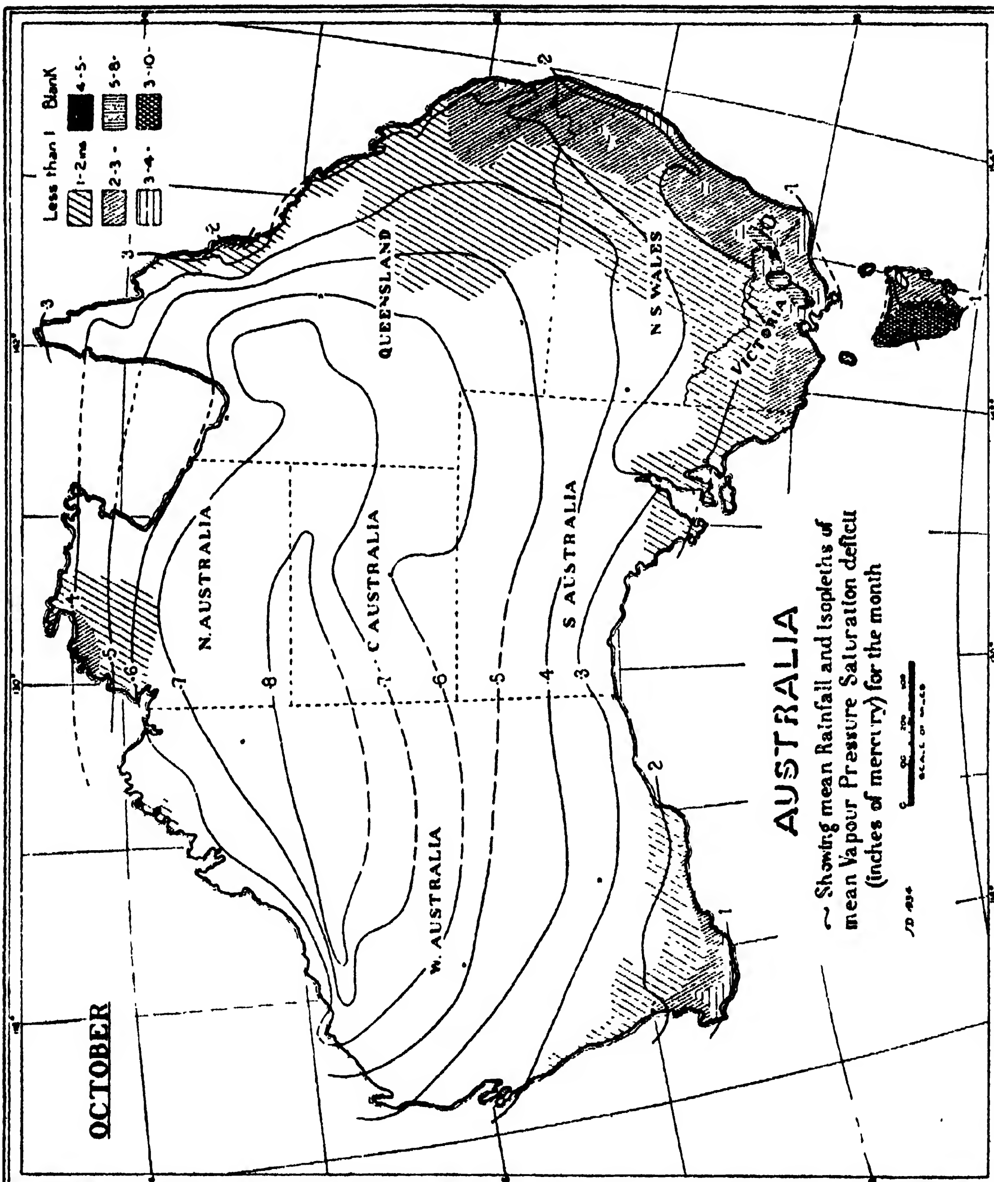
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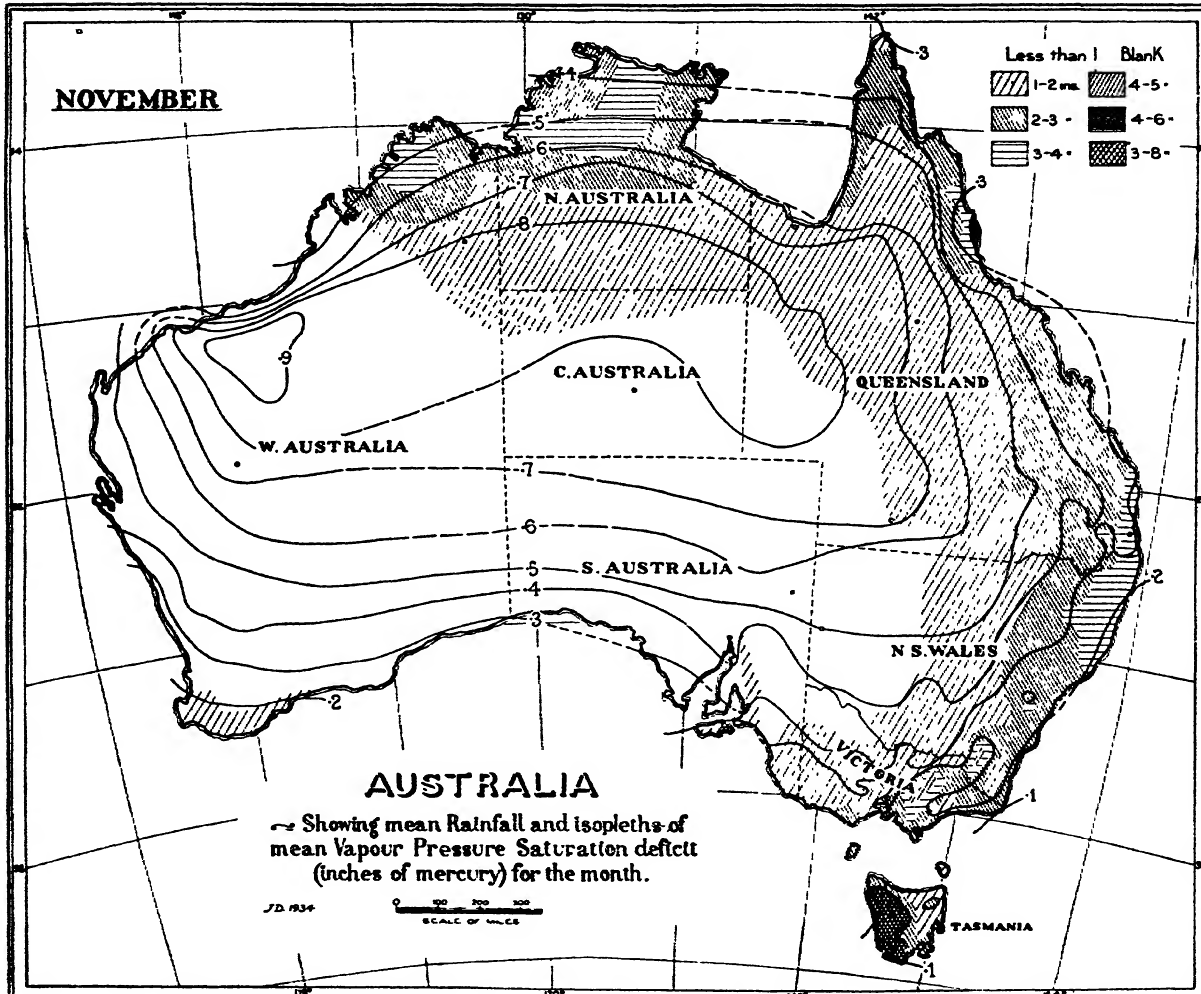
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(inches of mercury) for the month.
J.D. 1934
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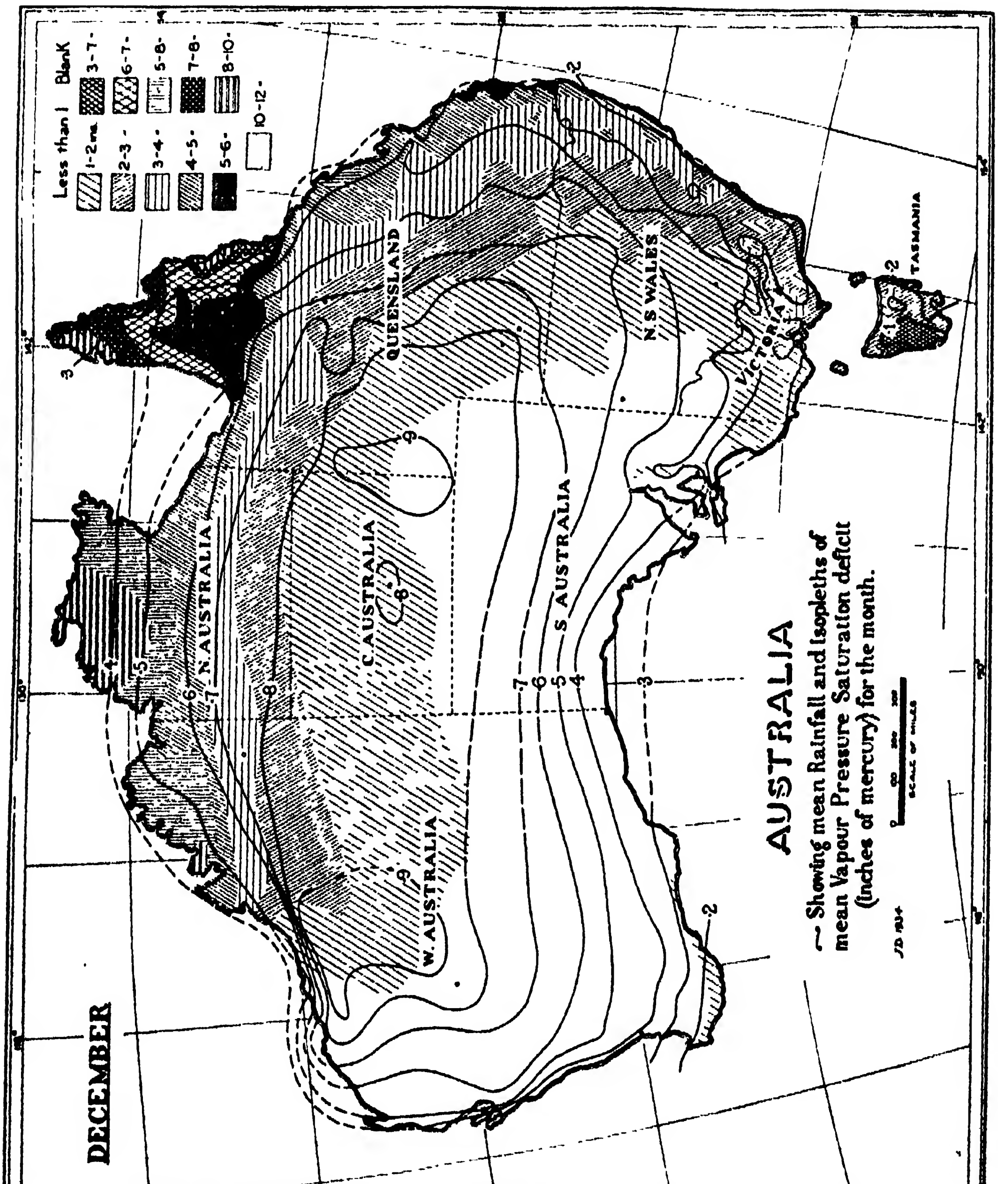

AUSTRALIA
Showing mean Rainfall and Isopleths of mean Vapour Pressure Saturation deficit (inches of mercury) for the month.

AUSTRALIAN FUNGI: NOTES AND DESCRIPTIONS.—No. 10.

By J. Burton Cleland, M.D.

[Read October 11, 1934.]

The present contribution gives descriptions in Latin of various Australian Fungi. Descriptions in English of Nos. 594 to 613 have already appeared in the author's "Toadstools and Mushrooms and other Larger Fungi of South Australia. Part 1." Government Printer Adelaide, 1934. To make these species valid, according to the Rules of Botanical Nomenclature, Latin descriptions must be supplied. Descriptions in English of the new species of *Boletus* (Nos. 614 to 619) here described have been prepared for Part II. of the above work.

594. *Tricholoma sublilacinum* Clel.—Planta sublilacina. Pileus ad 4·3 cm., irregulariter planus vel repandus, subumbonatus, glaber, hygrophanus, primo margine introversa, benzo-brunneus, ubi exsiccatus pallido-cinereus ad albidum. Lamellae adnatae, usitate dentibus decurrentibus, subconfertae, pallido-brunneo-cinereae. Stipes ad 3·1 cm., tenuis, saepe curvatus, substriatus, pallido-cinereus. Sporae ellipticae, obliquae, 6-7 × 3·5 μ. S.A.—Mylor.

595. *Collybia pinicolens* Clel.—Pileus 1·8-2·5 cm., planus vel subconvexus, umbilicatus, a margine striato-rugosus, pertenuis, sublentus, hygrophanus, "Rood's brown," ubi exsiccatus pallido-carneo-cinnamoneus. Lamellae adnatae, subconfertae, angustae, concoloratae. Stipes 6·2 cm., tenuis, aequalis, lentus, cartilagineus, pervillosus, concolaratus, ad basem inter pini folia fibrillis diffusis et filis myceliosis. Sporae obliquae, 8·5 × 4 μ. S.A.—Mount Burr.

596. *Entoloma Bloxami* Berk. var. *angulata* Clel.—Sporae angulatae, 8 × 5 μ. S.A.—Mount Burr.

597. *Hebeloma lamelliconfertum* Clel.—Pileus ad 8·7 cm., convexus, deinde subplanus vel subconcavus, interdum subrepandus, subfibrillosus, flavo-brunneus. Lamellae adnatae, deinde subsinuatae, confertae, pallido-flavo-brunneae, deinde flavo-brunneae. Stipes 6·2 cm., crassus, subfibrillosus, albidus. Sporae subangustae, pallido-brunneae, 9 × 4·5 μ. S.A.—Ashbourne.

598. *Flammula paludosa* Clel.—Pileus 1·8-3·1 cm., convexus, deinde subplanus vel irregulariter depressus vel concavus, subtomentosus, circum marginem flavo-brunneus, in centro brunneus. Lamellae adnatae vel subsinuatae, subconfertae, ventricosae, flavo-brunneae vel subfulvae. Stipes brevis, 1·2-1·8 cm., subtenuis vel subcrassus, aequalis vel infra attenuatus, farinaceus vel fibrillosus, solidus vel subcavus, flavo-brunneus, infra subniger. Sporae obliquiter piriformes, subasprae, flavo-brunneae, 9·5-11 × 6-7·5 μ. Prope paludem. S.A.—Mount Compass.

599. *F. excentrica* Clel. et Cheel. var. *macrospora* Clel.—Sporae 9·5-15 × 5·5-7·5 μ. S.A.—Upper Tunkalilla Creek, Kinchina, Mount Burr.

600. *F. eucalyptorum* Clel.—Pileus 1·2-3 cm., perconvexus, deinde expansus, villoso-fibrillosus vel substrigosus, rhamnoso-brunneus, fulvus vel succineo-brunneus. Lamellae sinuato-adnexae, subconfertae, angustae, subventricosae, inter ochraceum et ochraceo-lutem, ochraceo-fulvae, vel inter succineo-brunneum et "Sudan-brown." Stipes 1·2-3·7 cm., saepe curvatus, infra subfibrillosus, supra farinosus, solidus vel subcavus, supra pallidus, infra flavo-brunneus vel ochraceo-luteus. Sporae obliquiter ellipticae, saepe subasprae, flavo-brunneae,

7-9 × 4·5-6 μ. Plantae de Eucalyptorum truncis cariosis. S.A.—Kuitpo, Mount Lofty Ranges.

601. *F. arenario-bulbosa* Clel.—Pileus ad 3·7 cm. et magis, convexus, villoso-fibrillosus, subsquamosus vel subrimosus, ochraceo-luteus ad fulvum. Lamellae sinuatae, subconfertae, ventricosae, isabellinae. Stipes brevis, 2·5 cm., fibrillosus, subcavus, ad basem bulbo arenario-incrustato, ochraceo-luteus. Velum subflavum, stipem vestiens. Caro flava. Sporae ellipticae, flavo-brunneae, 8·5 × 5·6 μ. S.A.—Encounter Bay.

602. *Naucoria subfulva* Clel.—Pileus 16 mm., convexus, interdum subumbilicatus, tomentosus, ochraceo-fulvus ad fulvo-olivaceum. Lamellae adnatae ad sinuato-adnatas, subventricosae, subconfertae, subcrispatae, tabacino-brunneae vel fulvo-olivaceae. Stipes brevis, 1·2 cm., tenuis fibrillosus, subcavus, subfulvo-pallidus. Sporae obliquae, pallido-brunneae, 8·5-11 × 4·5-5·5 μ. In terra. S.A.—Myponga.

603. *N. veronabrunnea* Clel.—Pileus 1.2-1·6 cm., perconvexus, subumbonatus, fibrillosus, hygrophanus, verona-brunneus, exsiccatus pallidus. Lamellae sinuatae, subconfertae, ventricosae, verona-brunneae, marginibus pallidioribus et serratis. Stipes 5 cm., aequalis, flexuosus, supra farinosus, infra fibrillosus, solidus, brunneo-pallidus. Sporae subangustae, obliquae, brunneae, 8·2 × 4 μ. In terra. S.A.—Mount Lofty.

604. *Crepidotus prostratus* Clel.—Pileus approxime 3-6·2 × 3-5 cm., irregularis, subconvexus, in medio depressus, furfuraceo-squamosus vel subtomentosus, interdum margine substriato, hygrophanus, ochraceo-fulvus ad ochraceum vel brunneus, ubi exsiccatus fulvo-olivaceus. Lamellae subconfertae, perdecurrentes, interdum anastomosae, rhamnoso-tabacino- vel cinnamoneo-brunneae. Stipes subcentralis, excentricus vel sublateralis, brevis, 1·2-1·8 cm., subcrassus (7 mm.), solidus, albus vel pallidus. Sporae ellipticae, flavo-brunneae vel brunneae, 8-9·5 × 4·8-5·5 μ. Plantae caespitosae et imbricatae ad truncorum bases. S.A.—Monarto South, Kinchina, Coonalpyn, N.S.W.—Bumberry.

605. *Psilocybe asperospora* Clel.—Pileus 7·5 cm., conico-convexus, subgibbosus, brunneus, fibris fasciculatis. Lamellae adnatae, saepe subdecurrentes, subconfertae, subnigrae. Stipes ad 15 cm., subcrassus, filis subnigris fibrillosus, supra punctis subnigris pruinosus, subcavus, brunneo-pallidus. Velum superius. Sporae asperae, ovales, obliquae, subnigrae, 8·5-12 × 7 μ. S.A.—National Park.

606. *Ps. subuda* Clel.—Pileus 1-2·5 cm., campanulato-convexus vel hemisphericus, viscidus vel subviscidus, interdum substriatus, isabellinus vel ochraceo-fulvus, margine olivaceo-ochraceo. Lamellae adnatae, triangulares, subconfertae, flavo-virides deinde fusco-cinereae, marginibus albis. Stipes 6·8-7·5 cm., tenuis, aequalis, nitidus, interdum substriatus, subcavus, pallido-brunneus vel ochraceo-fulvus. Sporae ellipticae, purpureo-fuscae, 13-19 × 8·5-10 μ. In stercore. S.A.—Mount Compass, Myponga, National Park, Waterfall Gully.

607. *Ps. echinata* Clel.—Primum pileus globosus, echinatus; deinde 18 mm., hemisphericus ad convexum ad subplanum, subfibrillosus, fuscus, Lamellae adnexae, confertae, angustae, rubicunda-brunneae deinde fuscae. Stipes 2·5-3·1 cm., aequalis, fibrillosus deinde glaber, subcavus, pallidus deinde brunneo-pallidus, ad basem mycelio floccoso. Sporae ellipticae, obliquae, fuscae, 7-7·5 × 4 μ. Plantae gregariosae ad subcaespitosae, ad bases truncorum cariosorum. S.A.—Mount Lofty.

608. *Russula Cheelii* Clel.—Pileus 7·5 cm., convexus in medio depressus, viscidus, luteus, margine subrugosa. Lamellae adnatae, confertae, proxime stipiti saepe furcatae, angustae, cremaceae deinde submaculatae. Stipes 6·2 cm.,

subaequalis vel infra subattenuatus, substriatus, albus. Sapor mitis. Sporae piriformes, verrucosae, 8·5 × 6·5 μ. S.A.—Kuitpo.

609. *Coprinus sterquilinus* Fr. var. *radicatus* Clel.—Stipes radice fastigata, longa, 1·2-3·7 cm. Plantae inter gramina, non in stercore. S.A.—Kinchina, Encounter Bay, Beaumont.

610. *Marasmius cinnamoneus* Clel.—Pileus ad 1·2 cm., irregulariter convexus, deinde subplanus, subvillosus, subrugosus, interdum, circum marginem substriatus, pallido-carneo-cinnamoneus ad carneo-luteum, pallido-vinaceo-cinnamoneus vel pallido-ochraceo-salmonicolor. Lamellae adnatae, deinde secedentes, subconfertae ad subdistantes, subventricosae, deinde marginibus subserratis, cremaceo-albae. Stipes ad 1·2 cm., deinde 2·5 cm., tenuis, subvelutinus vel glaber, "Hessian brown" vel "Vandyke brown" vel pallidior, interdum infra subniger, matricem abrupte penetrans. Odor nullus. Sporae subsphericales ad piriformes, apiculo obliquo, hyaline, 7·5 × 6 μ, 7·5-9 × 4 μ. De cortice ad bases Eucalyptorum vivorum. S.A.—National Park, Mount Lofty, Willunga Hill, Inman Valley.

611. *M. villosipes* Clel.—Pileus 1·2-2·7 cm., irregulariter convexus, interdum irregulariter rugosus, margine lacerato, subnigro-brunneus, ubi exsiccatus colore graminis sicci. Lamellae adnatae, subconfertae ad subdistantes, avellaneae. Stipes 3·1-3·7 cm., tenuis, lentus, pervillosus, subnigro-luteo-brunneus. Sporae piriformes, 5·5 × 3·5 μ. In terra sub pinis vel inter gramina. S.A.—Mount Gambier, Kalangadoo.

612. *M. australiensis* Clel.—Pileus 15 mm., convexus, umbilicatus vel irregulariter planus, irregulariter subrugosus, subfibrillosus, "Sayal brown." Lamellae adnatae, subconfertae, glauco-brunneae. Stipes ad 18 mm., infra subattenuatus, pervillosus, cinereo-brunneus. Sporae 7·5 × 3·5 μ. In ligno. S.A.—National Park.

613. *Cantharellus ochraceus* Clel. — Pileus 2·5-3·7 cm., convexus, subirregularis, ochraceo-fulvus et cinnamoneus. Lamellae arcuate subdecurrentes, subdistantes, interdum in exteriores partes furcatae, pallido-ochraceo-luteae. Stipes 3-3·7 cm., subirregularis, infra attenuatus vel irregulariter crassus, subfibrillosus, ochraceo-luteus. Sporae piriformes, 6·5 × 4 μ. In terra. S.A.—National Park.

614. *Boletus fuscus,* n. sp.—Pileus 7·5 cm., convexus, viscidus, fuscus. Tubuli 1·2 cm., antiquo-aurei, ubi contusi livido-virides, ubi caesi cyaneo-virides; oribus sublargis et irregularibus. Stipes 6·2 cm., crassus (1·8 cm.), supra reticulatus, infra subpunctatus, solidus, fuligino-brunneus. Caro subbrunneo-albida. Sporae elongatae, pallido-brunneae, 9-10 × 3·75 μ. S.A.—Mount Lofty.

615. *B. punctato-brunneus,* n. sp.—Pileus 8·7-12·5 cm., irregulariter convexus ad subplanum, viscidus, deinde velutinus, Verona-brunneus ad sepia-brunneum. Tubuli 1·2-1·8 cm., circum stipitem sulcus, pallido-flavi, deinde sordido-flavi, deinde olivacei; oribus subparvis. Stipes 3-8·7 cm., tenuis ad crassum (1·8-4·6 cm.), aequalis vel infra attenuatus, punctato-brunneus. Caro subrubra vel sordido-brunnea, interdum apud tubulis cyaneo-viridis. Sporae elongatae, pallido-brunneae, 9-12 × 3-4 μ. S.A.—Waterfall Gully, Mount Lofty, Second Valley, Middleton, Kangaroo Island.

616. *B. sinape-cruentus,* n. sp.—Pileus 7·5-12·5 cm., convexus, raro in centro depressus, viscidus, sinape-croceus et cruentus et brunneus. Tubuli 5-25 mm., circum stipitem sulcus, intus attenuati, subventricosi, angulati, sinape-crocei vel lutei vel melleo-flavi; oribus 0·5-1 mm. Stipes 5-7·5 × 1·8 cm., infra et interdum supra attenuatus, luteus ad sinape-croceum, rubro-punctatus. Caro primulino-crocea, in locis cyaneo-viridis. Sporae elongatae, brunneae, 10·5-15 × 4-5 μ. S.A.—National Park, Mount Lofty, Eagle-on-the-Hill.

617. *B. multicolor,* n. sp. — Pileus 5-7·5 cm., convexus, subtomentosus, olivaceo-et rubicundo-brunneus, ruber et croceus. Tubuli 6-12 mm. circum stipem sulco, succineo-flavae vel croceae; oribus minutis. Stipes 2·5-11·2 cm., crassus (in medio 3·7 cm., supra 2·5 cm.), interdum ad basem attenuatus, subgranulosus vel subrugosus, croceus maculis rubicunda-brunneis. Caro crocea, deinde subrubra vel cyanea. Sporae elongatae, pallido-flavae, 9·5-11-13 ×2-4 μ. S.A.—Bangham, Encounter Bay, Mount Compass, Second Valley, Kinchina.

618. *B. fuscescens,* n. sp.—Pileus 6·2-13·7 cm., perconvexus, saepe in centro depressus, saepe subirregularis, mollis, velutino-fibrillosus, probabiliter subviscidus, tabacino-brunneus vel cinnamoneo-cinereus vel subfuscus. Tubuli 1·2-1·8 cm., circum stipitem sulcus exiguus, intus et extra attenuati, olivaceo-lutei ad "chamois," deinde subfusci; oribus rotundis, duobus vel minus in 1 cm. Stipes 5-6·2 c.m,, crassus (1·8-4·3 cm.), primo perbulbosus, satur-olivaceo-luteus deinde fuscus, punctatus. Caro pallida, deinde fusca et subnigra. Sporae elongatae, subbrunneae, 9-13 × 3·2-4 μ. S.A.—Encounter Bay, Kuitpo, Willunga Hill, Mount Lofty, MacDonnell Bay.

619. *B. mollis,* n. sp.—Pileus 8·7 cm., subplanus, viscidus, flavo-brunneus ad martis-brunneum. Tubuli 2·5 cm., circum stipitem sulcus, cinnamoneo-cinerei et cinereo-carnei; oribus 1 mm., irregularibus. Stipes 3·7 cm., subtenuis, supra expansus, subfibrillosus, infra badius, supra pallidior. Planta mollis. Sporae elongate, brunneae, 17-18·7 × 5 μ. S.A.—Penola.

NOTES ON THE FLORA OF SOUTH AUSTRALIA.—No. 3.

By Ernest H. Ising.

[Read October 11, 1934.]

Casuarinaceae.

A review of certain species of *Casuarina* contained in an article (4) by E. D. Macklin gives information which will help in the diagnosis of this difficult genus. Amongst other details Macklin says:—"The following are the most important vegetative features: the angularity of the ridges, the size and nature of the sheathing teeth in each whorl and the length of the internodes. As regards the cones of the species dealt with in this paper, only the presence or absence of the dorsal protuberance of the valves and the degree of protrusion of the latter are worth consideration. The greatest assistance to taxonomic work . . . is to be gleaned from the male inflorescence. The average length of the male spike and the colour of the anthers are useful, while the arrangement of the sheaths on the axis, whether they are overlapping, merely touching or moniliform, is a relatively constant feature. The condition of the male flower when mature has been found to be a very valuable aid . . . The bracteoles may be retained in the open flower as in *C. lepidophloia* F. v. M. (recently found by the writer to be synonymous with the previously named *C. cristata* of Miquel), *C. distyla* Vent. (*C. rigida* Miq.), *C. paludosa* var. *robusta* Macklin, *C. paradoxa* Macklin, n. sp. (*vide* p. 150), *C. Muelleriana* Miq. and *C. Baxteriana* Miq. In few cases they are shed, leaving the mature flower consisting of one stamen and its sheathing bract, *e.g.*, *C. stricta*, *C. Luehmanni* and *C. striata*. In *C. stricta* the two bracteoles are woody and cohere along the upper abaxial margin by means of branching hairs. The relative size of the persistent bracteoles to the sheathing teeth also appears to be constant, and can, therefore, rank among the more specific characteristics of the genus."

The correct name, therefore, of one of our South Australian species is as follows:—

C. cristata Miq. Rev. Cas. 70, t. 10A (C. lepidophloia *F. v. M.)*, Fragm. X, 115, 1877.

Chenopodiaceae.

Bassia All. Both Black (1) and Anderson (2) have found this a difficult and variable genus, and my recent study of it (3) has confirmed the views of these two. There is a diversity in the various parts of a species, and it is often necessary to widen the description to admit a new form which has been found. Variations occur in a number of the parts of a plant, the chief points of difference are in the number, position and size of the spines and in the vestiture, although the leaves vary too. The following notes add further details to known species, and one is definitely recorded for South Australia for the first time.

B. articulata J. M. Black, in these Trans., lvii. (1933), 150. I have a specimen from Pedirka (No. 2,859) collected on August 21, 1932, which differs from the type in the spines, 2 of which are 4½-6½ mm. long, one, which is always smaller than the others, is only 1½-3 mm. long, usually less than 3 mm.; there is sometimes a fourth spine present as a tubercle situated at the base of one of the larger spines.

B. ventricosa J. M. Black. A specimen (No. 2,889) collected at Curdimurka on August 19, 1932, has one spine 7 mm., one 5 mm., and a third about 1 mm.

long. Black's Flora (p. 191) gives the longest spines as 3-5 mm. in length. There is a specimen in the Tate Herbarium, from Mount Parry, June 4, 1883, having spines up to 8 mm. long.

B. eriacantha (F. v. M.) R. H. Anderson. At Pedirka a specimen was collected (No. 2,897) on August 29, 1932, which shows certain variations from the type, *viz.*, two tubercles besides the two spines are often present, Black (1) gives 2 spines and a tubercle and Anderson (2) records 3 spines occasionally; the two longest spines are villous to their summit and the base is not much oblique and is ovate to oblong.

B. quinquecuspis F. v. M. In sandhills at Pedirka, about 70 miles north of Oodnadatta, this species was collected in three locations, Nos. 2,885, 2,892 and 2,893, August 26, 1932. This is the *first record* for South Australia, although this name appears in the Flora of South Australia (1), *l.c.*, p. 194, the following note is appended:—"This species, common in the dryer parts of New South Wales and Queensland, has been found close to our eastern border at Milparinka and elsewhere, so that it must almost certainly occur in this State."

B. intricata R. H. Anderson. The collection of specimens at Wangiana (No. 2,663), Macumba (Nos. 2,671 and 2,672) and Pedirka (Nos. 2,869, 2,874, 2,883 and 2,895) *extend the now known range* about 400 miles further north. A specimen is in the Tate Herbarium, collected by E. G. Millard on the Warburton River, which is also known as the Diamantina River, another specimen came from Mount Nor'-west, 16 miles north-west of Farina.

B. patenticuspis R. H. Anderson. A specimen was collected at Snake Gully, near Pedirka (No. 2,903), on September 1, 1932, which appears to be a form of this species with a scanty vestiture of hairs giving the plant a different aspect; the spines are also more divergent; the leaves are up to 20 mm. long and the fruiting perianth is flattened.

B. lanicuspis F. v. M. *A slender form*, smaller in all its parts, was found at Bloods Creek (Nos. 2,863 and 2,864) on September 3, 1932. The different aspect of this plant, with its smaller fruits and leaves, distinguishes it from the typical form, but as other specimens connect this form with the type there is no justification for creating even a new variety. The average length of the leaves is from 5 to 6 mm. and of the spines from about 2 to 4 mm.

Threlkeldia inchoata J. M. Black. *Central Australia:* Coglin Creek, August 26, 1931, No. 2,930. This specimen was found just across the border and appears to be the *first record for Central Australia.*

T. proceriflora F. v. M. The occurrence of this species is given by Black (1), *l.c.*, p. 203, from two localities only, *viz.*, Mount Lyndhurst and Abminga Creek, which are separated by about 400 miles. I have collected this species at a number of places between these two points, as follows:—Callana, August 21, 1931 (No. 2,940); Macumba, September 1 and 5, 1931 (Nos. 2,938 and 2,939); Pedirka, August 22, 1931 (No. 2,936), and August 21 and 29, 1932 (Nos. 2,934 and 2,941); near Stevenson River, September 3, 1932 (No. 2,933); and Bloods Creek, September 3, 1932 (No. 2,942). All these specimens are more or less hairy.

AMARANTHACEAE.

Alternanthera denticulata R. Br. Specimens were collected at Abminga, August 22, 1931 (No. 2,456) and at Bloods Creek, September 3, 1932 (No. 2,947), both in our Far North, which is the *first record* north of the Flinders Range and extends its distribution by about 400 miles.

A. angustifolia R. Br. *Central Australia:* Wall Creek, just beyond our border, August 26, 1931 (No. 2,455), *first record* for Central Australia.

Trichinium nobile Lindl. Hitherto the farthest north record for this species has been the Flinders Range, but its range *is now extended* into the Far North

at Dalhousie Station (No. 2,959), September 6, 1932, and at Macumba (Nos. 2,422 and 2,423), September 1 and 5, 1931.

T. macrocephalum R. Br. Emery Range near Dalhousie Station, September 6, 1932 (No. 2,961), and Snake Gully, near Pedirka, September 1, 1932 (No. 2,962), both in our Far North. These two records create a gap of over 700 miles between the north and south localities for this species. The only previously known occurrence was in the South-East, from Bordertown southwards.

There is, however, a difference in published descriptions in connection with the ovary. Black's Flora of S.A. (p. 213) and Ewart's Flora of Victoria (p. 475) state the ovary to be pubescent; Bentham's Flora Austral. V. (p. 225) gives the ovary as glabrous, and I find that my specimens (as above) are certainly glabrous. I examined a specimen in the Tate Herbarium (Adelaide University) from Mount McIntyre, in our South-East, and the ovary is glabrous with sometimes a very scanty pubescence observable. Bentham examined specimens from Queensland, Victoria, and New South Wales.

T. semilanatum Lindl. A specimen was collected at Pedirka, August 30, 1932 (No. 2,964), having the older flower heads developed into cylindrical spikes up to 4 cm. in length. Bentham's description (5), however, definitely states "heads at length globular." The Pedirka specimen reveals other divergences from the above description in that the perianth segments are unequal, the two outer being longer than the three inner and the ovary is often glabrous or nearly so, with a style less than half the length of the flower.

Ptilotus latifolius R. Br. This rare plant was found in *Central Australia* at Horseshoe Bend, August 23, 1931 (No. 2,417). Ewart (6) states that it is recorded in the Melbourne National Herbarium census as from North Australia, but it is shown under the name of *Trichinium*, which is evidently an oversight for *Ptilotus*. There are specimens in the Tate Herbarium as follows:—*Central Australia:* Idracowra, May 23, 1895; latitude 23·50°, longitude 129·35°, which is near the Western Australian border; *South Australia:* Blanchewater, which is 85 miles east of Marree.

Cruciferae.

Stenopetalum nutans F. v. M. This somewhat rare plant I collected in our Far North at the following localities:—Abminga, August 27, 1931 (Nos. 2,497 and 2,499); Snake Gully, September 1, 1932 (No. 3,054); Pedirka, August 28, 1932 (Nos. 3,055 and 3,056). The localities from which it was previously known, as recorded by Black (*l.c.*, p. 255), are near Cooper's Creek and the Musgrave Range. The former is in the north-east part of the State, and the latter in the north-west, and my localities, as shown above, occur in the country between, thus spanning a 700-mile gap across the State. The pods, besides having one central nerve on each valve, are reticulate-veined also.

References.

1. J. M. Black, Flora of South Australia (1924), 190.
2. R. H. Anderson, Proc. Linn. Soc. New South Wales, xlviii. (1923), 328.
3. E. H. Ising, these Trans. lvii. (1933), 91 and 181.
4. Kew Bulletin (1931), 145.
5. G. Bentham, Flora Australiensis, v. (1870), 227.
6. A. J. Ewart, Flora of the Northern Territory (1917), 100.

ON MAMMALS FROM THE DAWSON AND FITZROY VALLEYS; CENTRAL COASTAL QUEENSLAND.—PART II.

By H. H. Finlayson,
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[Read October 11, 1934.]

Phalangeridae.

In a richly forested tract of equable climate, supporting many arborescent species which bloom freely at rather widely-spaced intervals, one may confidently look in Eastern Australia to a generous representation of this arboreal family. In the area of coastal Queensland now under consideration, all three types of alimentation of the phalangers are lavishly catered for, and phytophagy, insectivority, and nectar-sipping are simultaneously possible throughout a large part of the year.

While this leads to a numerous representation both of species and individuals, it is, nevertheless, noteworthy that all the forms which occur here have an almost uninterrupted distribution throughout the Eastern forest tract, from Cape Otway in the south, far up into the Cape York Peninsula, without loss of specific identity. The extreme northern and southern representatives of these species can frequently be distinguished as distinct subspecies, and it may be, that true geographical races with circumscribed ranges may yet be brought to light by systematic collecting, but in most cases the passage from north to south effects so gradual a change that the use of trinomials in middle Queensland is subject to a good deal of uncertainty.

This is increased by the lamentable neglect to describe seasonal changes in the pelage of mammals, which is so considerable in some of the species here listed as to undermine one's faith in the significance of the slight differences which have been recorded as distinguishing some so-called varieties.

The typical Torresian forms, such as *Dactylopsila* and the jungle *Pseudochiri* characteristic of the more tropical conditions further North, are absent from the area.

In this and the succeeding families most of the specimens reviewed were taken in the low-lying country of the lower Fitzroy Valley, north of Rockhampton, and not in the Dawson Valley proper, but comments on distribution and status apply to both watersheds.

Pseudochirus laniginosus oralis (Thomas).

As in most parts of their joint range, the "ringtail" here is much less numerous than *Trichosurus*, but is almost equally ubiquitous and was observed from Spring Creek, near Taroom, in the south, to the Serpentine Creek, in the north. The series examined comes entirely from the latter locality and is possibly not strictly typical of the area as a whole.

Owing to its short coat it is of little value to furriers, but large numbers are killed during open seasons owing to the impossibility of discriminating effectively between ringtails and brushtails in snaring, trapping and shooting. Its habits appear to be much as in the South, except that nest-building in the lower growth seems to be less frequently resorted to.

Unlike *Trichosurus*, the local *Pseudochirus* is very constant in its pelage characters, and except for an increased density the winter coat is exactly like the summer one. In its clear grey dorsal colouration with strongly contrasted "orange

cinnamon" limbs, it is in good agreement with Thomas's var. *oralis*[1] from a point about 300 miles north of the location of my series. Thomas, however, states that the head in *oralis* is "dark grey, but little more tawny round eye." In the present series the facial area is pretty uniformly a pale buff grey to the crown and the eyes are prominently conspicillate with cinnamon.

No reliable flesh measurements are available, but the tail appears to be decidedly longer and more slender than in the southern races of this species, and distally it is white for more than half its length. Thomas's measurement of 53 mm. for the pes is evidently a misprint for 35 mm.

The skulls show constantly a series of not unimportant features which serve to distinguish *oralis* from the southern races. Thus (1) the muzzle region is heavier, with longer nasals which taper evenly forward with their outer margins straight and not concave, so that each bone is evenly wedge-shaped; (2) the interorbital region is less constricted (7·6 : 7·1); (3) the anterior palatine foramina and palatal vacuities are larger; (4) P^4 is smaller in *oralis* (2·8 : 3·3 mm.); (5) the upper molar series is shorter—attaining a maximum of 14 mm. as against 14·5.

In making these comparisons I have had to rely on series derived largely from western Victoria and south-eastern South Australia. If it can be shown that the differences are equally marked when the comparison is extended to true *laniginosus* of New South Wales and south Queensland, the separation of *oralis* as a full species might be justified, though it is obviously very closely related to *laniginosus*.

This appears to be the only species of *Pseudochirus* in this part of Queensland.

Skull dimensions of the largest ♂:—Greatest length, 59·8; basal length, 54·4; zygomatic breadth, 34·5; nasals, length, 21·7; nasals, greatest breadth, 11·0; P^4, 2·8[2]; upper M^{1-4}, 13·5.

Seven skins and skulls examined.

PETAUROIDES VOLANS INCANUS (Thomas).

A common species in open eucalyptus parks over the whole of the Dawson Valley and the lower Fitzroy, and as little if any commercial use is made of the pelt, the "accidental" killings during opossum seasons seem to be the only causes of mortality on any large scale, and it is likely to persist as long as the timber stands. Nine specimens examined, all from the Serpentine Creek area.

These form a fairly uniform series, though the single mid-summer skin conspicuously lacks a brownish tinge which is noticeable in the dorsal fur of the remainder, which were taken in mid-winter. They agree with Thomas's variety *incanus*,[3] and differ from most examples from Victoria and southern New South Wales, in their lighter, more grizzled, dorsal body colour, which leaves the brownish-black outer aspects of the ears and limbs in stronger contrast than in the typical variety, and in the much lighter colour of the tail, which is black for its distal third only, or even less, the colour fading proximally through shades of brown and greyish-brown, to the paler slaty-grey of the basal portion. Ventrally, however, none of my skins are "whitish," but range from a decided cream to a pale buff.

Although easily distinguished from most examples of *typicus* from the southern parts of its range, it is significant that the changes which culminate in

(1) Ann. Mag. Nat. Hist., ser. 9, vol. xvii (1926), p. 631.

(2) Tooth measurements, unless otherwise stated, apply to the upper series.

(3) Ann. Mag. Nat. Hist., ser. 9, vol. xi., p. 247.

the *incanus* and *minor* characters are initiated at least as far south as the Strathbogies in Victoria, where grizzled individuals are sometimes met with, and in southern New South Wales the light tail base occurs in a large proportion of individuals. Thomas states that one-third of his examples showed pigmentation deficiencies in the fur of head and tail, but so far as I can ascertain, the beautiful pale phase of southern New South Wales,[4] in which the whole dorsum becomes a nearly uniform smoke grey, does not occur in the Dawson Valley.

I have no specimens from Coomooboolaroo, whence came the so-called variety *armillatus* of Thomas. That place, however, lies between the type locality of *incanus* and the Serpentine Creek area which afforded the present series of *incanus,* and there is little in its physiography or vegetation to provide sufficient ecological change to account for the abrupt appearance of another form in so restricted an area. *Armillatus* I judge to be founded on a slightly stunted example of *incanus.*

The following dimensions, derived from freshly-killed adult animals, relate to: (1) a male of *incanus* from the lower Fitzroy Valley; (2) a male of *typicus* from the Tumut district of New South Wales, 900 miles south of the first locality; and (3) the range in six females of *typicus* from the same place.

Head and body, 390, 410, 395-440; tail, 460, 480, 485-530; pes, 50, 56, 52-56; ear, 43 × 28, 44 × 27, (44 × 22) — (46 × 31); weight, ———, 1,000 grammes, 890-1,335 grammes.

Skull dimensions of the largest *incanus* male taken:—Greatest length, 61·3; basal length, 55·1; zygomatic breadth, 39·8; nasals, 15·9 × 10·5; palate, breadth inside M^2 (at ant. angle), 11·6; constriction, 7·1; palate, length, 31·8; anterior palatal foramina, 6·7; basi-cranial axis, 19·0; basi-facial axis, 36·4; P^4, 2·3; M^{1-3} (upper), 11·0.

PHASCOLARCTOS CINEREUS ADUSTUS (Thomas).

The tenure of the koala in the Dawson Valley seems to have been a waning one for many years, and the last open season reduced it to such an extent that it is now a rare animal in many parts of the valley where it was formerly very plentiful. The process has been hastened, too, in some places, by an epidemic, and on Coomooboolaroo in the summer of 1929 several were seen in comatose condition at the base of feeding trees. The single example in this condition which was examined closely was an aged male, and though emaciated was not heavily infested with endoparasites, nor obviously diseased organically.

Here, as in the south, is has a marked preference for open eucalyptus parks, and shuns scrubs. Its chief feeding trees are the lemon-scented gum *(E. maculatus citriodora)* and the Moreton Bay Ash.

It was observed and collected at Thangool on the Cariboe, at Coomooboolaroo, and near Mount Hedlow, on the Fitzroy.

Thomas's variety *adustus*[5] was based on an animal from Mundubbera, on the Upper Burnett, about 100 miles from my Thangool specimens and in similar country. The five specimens obtained agree with Thomas's description moderately well and differ from Victorian animals in their shorter coat, duller colouration, and smaller size. These differences, however, although marked in some specimens, are subject to much variation. The skull, also, does not seem to be *proportionally* smaller than in the southern animal, as might be inferred from Thomas's account. A longer ear seems to be a constant attribute in *adustus,* but the relative nakedness mentioned by Thomas is not a good character—some

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[4] The light phase of *var. minor,* mentioned by Collett (Zool. Jahrb., Band II., 1886-1887), is evidently much less completely bleached than in this form.

[5] Ann. Mag. Nat. Hist., ser. 9, vol. xi. (1923), p. 246.

examples having the ear as heavily furred as is usual in the south. Nor is there a conspicuously rufous suffusion in any of the five skins examined. Seasonal change slight.

The following are the flesh dimensions of a ♂ and ♀, both aged, from the Dawson Valley:—

Head and body, 665, 635; pes, 90, 82; ear, 73 × 58; 68 × 55; weight, 14 lbs,. 12 lbs.

Skull dimensions of this ♂ are:—Greatest length, 139·2; condylo basal length, 129·1; zygomatic breadth, 80·1; nasals, 37·2 × 40·1; constriction, 23·5; palate, length, 66·5; palate, breadth inside M^2 (at ant. angle), 20·1; ant. palatal foramina, 3·6; basi-cranial axis, 41·5; basi-facial axis, 84·0; P^4, 7·2; $M^{s\,1\text{-}4}$ (upper), 28·2.

The skull is less massive than in similarly aged individuals from Victoria, but does not differ structurally in any important way. The teeth are proportionately larger, however, having the same dimensions as in the larger southern skull.

In view of the even distribution of the koala (until recently) throughout all the East Coast lands from the 19° to 39° parallels, and the general similarity of the forest country which it selects, it does not seem probable that the mid-Queensland animal should constitute a distinct race, abruptly differing from its neighbours to the south. The few examples of the New South Wales representative which I have examined, seem to me to be quite intermediate between Victorian and Queensland ones, and I have no doubt that a series adequately representing the whole of its range would show a steady gradation of characters—the passage from south to north being accompanied by a decrease in average size, dulling of colouration and (at similar altitudes) shortening of the coat.

Thomas does not list the specimens which he examined, but evidently considers that *adustus* continues as far up the coast as Inkerman, 500 miles north of Mundubbera. If this is so, it is a matter for regret that the former place was not made the type locality, since if this is the northern limit of the range of *Phascolarctos*, it is probably also the point at which its distinction from the southern animal reaches its maximum.

Acrobates pygmaeus (Shaw).

Four specimens from the lower Fitzroy, within 30 miles of Rockhampton, where it is still, as in Lumholtz's time, fairly plentiful.

Of these only two (a skin and skull and a spirit specimen) are in sufficiently good condition for comparison with southern material, and so far as pelage and general external characters go, they agree closely with examples from Victoria and south-eastern South Australia.

In seeking parallels for what was at first thought to be an anomaly in one Queensland specimen, I have been struck with the wide variation which occurs in the surface appearance and arrangement of the sole pads in series of *Acrobates* from quite restricted areas. The varying degrees of desiccation and distortion which take place in material preserved in alcohol of differing concentration, make it difficult to define these features except with fresh material, but two distinct conditions seem to exist. In one (the more frequent), 3 true interdigital pads are present, which, though somewhat amorphous in themselves, are surmounted by a well-defined, bluntly oval or rotund tubercle showing obscure concentric striation.

In another type the 3 interdigitals give place to 4 basi-digital elevations, or even to one irregularly-shaped cushion, which is surmounted by 4 very elongate tubercles converging slightly towards the centre of the sole. The apical, thenar and hypo thenar pads and tubercles are more constant, but the depth and pattern

of the striation varies considerably, as does the degree of granulation of the low-lying areas of the sole and under-surface of digits.

Dimensions of an adult ♀ from the Serpentine Creek area (measured in alcohol):—Head and body, 65; tail, 80; pes, 13; ear, 9·5.

Skull of another, slightly immature:—Greatest length, 20·0; basal length, 17·1; zygomatic breadth, 12·7; nasals, length, 7·0; interorbital breadth, 4·5; palate, length, 9·8; $M^{s\,1\text{-}3}$ (upper), 2·7.

No specimens of *Dromicia* nor of *Eudromicia* were taken, nor any reliable records of their presence in the area obtained.

Petaurus australis reginae (Thomas).

Three specimens from the Rocky Water Hole in the Serpentine Creek, about 28 miles north-east of Rockhampton. This *Petaurus*, although much scarcer than *Petauroides*, is yet a fairly common animal on the Dawson and Fitzroy, and is much more plentiful in this part of Queensland than either *sciureus* or *breviceps*.

The three examples are adult females and agree with Thomas's var. *reginae*.[6]

Two specimens from Herberton, 600 miles further north, which I have compared with them, are larger, much darker and more richly yellow, and externally appear to be closer to the typical race than the Fitzroy ones, in spite of their geographical remoteness.

In the three *reginae* females, head and body range from 280-290, and tail 400-450.

The range of skull dimensions is:—Greatest length, 52·5-55·0; basal length, 44·9-47·9; zygomatic breadth, 36·9-37·8; nasals, (18·9-19·9) × (11·8-12·3); constriction, 10·2-10·5; palate, length, 25·8-26·0; palate, breadth inside M^2 (anterior angle), 10·4-11·1; P^4, 2·0-2·5; $M^{s\,1\text{-}3}$ (upper), 7·0-7·3.

Petaurus sciureus (Shaw) var. ?.

A single specimen from the Serpentine Creek area. Mr. Vallis, who captured it and who is well acquainted with its nearest allies, states that it is a very rare form here, but as very few bushmen discriminate between it and *breviceps* it is difficult to get any reliable information on its distribution.

Lumholtz found it "not uncommon" in 1882-1884 somewhat further north, and made the curious statement that, "like *Phalangista vulpecula*, it visits the lowlands only in winter and disappears entirely in summer." I have not been able to get any evidence in support of such a seasonal movement for any of the *Phalangeridae* in this part of Queensland. *T. vulpecula* was as plentiful on the low-lying lands as it was on the plateaus, in the mid-summer of 1929.

The single specimen (♀), judged by the sutural conditions of the skull, is slightly immature, but it evidently represents a rather smaller race, which differs from the New South Wales *typicus* besides, in having a much less bushy tail and more fulvous colouration particularly on ventrum. The metacarpus and digits are pale buff and rather strongly contrasted with the forearms.

It is extraordinarily similar in external characters to *P. breviceps ariel*. In the south the pure white belly fur and much bushier tail and larger size, generally suffice to distinguish the typical *sciureus* from typical *breviceps*, but the northern forms appear to be practically identical in all external features except that of size.

The skull, however, in addition to its larger size, has a relatively longer and more conical muzzle than *breviceps*, a higher facial index, less expanded nasals, more evenly spaced premolars, and distinctly heavier upper molars. The last is a critical distinction.

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(6) Ann. Mag. Nat. Hist., ser. 9, vol. xi., p. 249.

Dimensions (in flesh):—Head and body, 187; tail, 253.

Skull:—Greatest length, 44·3; basal length, 38·8; zygomatic breadth, 29·9; nasals, 15·0 × 6·8; intertemporal, 8·8; palate, length, 23·1; palate, breadth inside M^2 (ant. angle), 7·9; basi-cranial axis, 14·0; basi-facial axis, 26·2; facial index, 187; P^4, 1·8; M^{1-3}, 6·8.

It is possible that the present animal is identical with De Vis's *Belideus gracilis*(7) from north of Cardwell, though that animal (referred to *P. sciureus* both by Thomas in 1888 and Longman in 1930) appears to be even larger than the typical variety.

PETAURUS BREVICEPS ARIEL (Gould).

Widely spread but not a common animal in any part of the area. Five specimens in winter coat from the Serpentine Creek area, examined.

In separating the Papuan representative of *Petaurus breviceps* from that of the Australian mainland, O. Thomas, in 1888, merged Gould's *P. ariel,* from Port Essington, with the typical variety, thus taking no cognisance (in nomenclature) of the very considerable and evidently constant differences which separate the North Coast animal from that of New South Wales and Victoria. I have not examined specimens which are reliably localized on the North Australian coast, but three examples from Melville Island and three from Groote Eylandt, in the South Australian Museum agree closely with Gould's description and plate, and differ constantly from New South Wales, Victorian, and South Australian examples in that: (1) the dorsal coat is shorter, its general colour lighter and more fulvous, and the dorsal stripe is more prominent and extends from the coronal gland patch to the sacrum or beyond; (2) the belly fur is coloured a clear pale yellow, and there is no trace of the dark subterminal band which is responsible for the grey belly in the typical animal; (3) the black portion of the tail is rather sharply differentiated from the lighter proximal portions; (4) bodily size is distinctly smaller, with a smaller skull and greater degree of interorbital constriction.

These differences seem to demand the retention of Gould's name in subspecific form for the North Coast animal.

The animal from the Rockhampton district is to some extent intermediate between *ariel* and *typicus,* but is closer to *ariel* and in particular completely lacks the dark subterminal band on the belly fur which is yellow throughout though somewhat more ochreous than further north. The distinctions do not seem to me to call for another trinomial.

I am unable to give reliable flesh measurements, but the following values derived from three males in formalin would indicate that the general bodily size is not conspicuously smaller than in the south, nor, when allowance is made for contraction, are the ear and pes:—

Head and body, 160-175; tail, 200-215; pes, 24-25; ear, 25-27.

One skull only has been examined—an adult ♂. It is considerably smaller than the largest *typicus* males and has slightly lighter molars, but is otherwise identical.

Basal length, 32·2; zygomatic breadth, 26·5; nasals, 10·8 × 6·1; interorbital constriction, 8·2; palate, length, 18·7; breadth, inside M^2 (ant. angle), 6·7; P^4, 1·5; M^{1-3}, 5·2.

Longman's var. *longicaudatus,*(8) from the eastern shore of the Gulf of Carpentaria, is geographically nearer to the locus of the present series than is the type locality of *ariel,* but the variability in length of tail which can be demonstrated in the south, is so great that, in the absence of other data, its distinction from *ariel* seems rather doubtful.

(7) Proc. Linn. Soc. N.S.W., vol. vii. (1888), p. 619.

(8) Proc. Roy. Soc. Qld., vol. xxxvi., p. 9.

TRICHOSURUS VULPECULA TYPICA (Kerr).

An open season for opossums had been declared a few months prior to my arrival in the area, and many thousands had been taken by trappers, but the animal was still very abundant and widespread. It seems to be equally at home in all types of timbered country, Coolibah flats, Moreton Bay Ash belts, Ironbark plateaus, and even Brigalow scrubs, where these are interspersed with groups of Blackbutts, but the wet vine and soft wood scrubs are evidently not attractive to it.

O. Thomas[9] has already assigned specimens from Westwood, near Rockhampton, to the typical variety, and as the most northerly of my specimens is from about 20 miles north of that town, a similar agreement with the southern animal was to be expected. The Dawson Valley opossums vary within rather wide limits, but all the colour phases shown can be closely matched with animals from New South Wales, Victoria, and the South Australian mainland. The seasonal change in the coat, however, is more pronounced than in the south, and summer skins are normally very dilapidated and thinly furred, with a scanty brush. The dorsal colour in this condition is a pale ash grey and the fur is lifeless and dull, without the crispness and sparkle of the winter coat.

These summer phases are very similar indeed to the so-called subspecies from the north—*arnhemensis* of Collett and *eburacensis* of Lonnberg and Mjöberg, the seasonal variation of which has never been defined. The differences which separate Thomas's *mesurus* from Inkerman from the present animal also seem to be vanishingly small.

The *average* size of the species on the Dawson appears to be distinctly less than in Victoria and South Australia.

Flesh dimensions of a mature female from Thangool:—Head and body, 415; tail, 315; pes, 66; ear, 54 × 29.

The largest skull (doubtfully sexed) has:—Greatest length, 87·8; basal length, 80·6; zygomatic breadth, 51·7; nasals, 33·9 × 17·0; constriction, 7·8; palate, length, 46·0; palate, breadth inside M^2 (ant. angle), 16·0; ant. palatal foramina, 6·3; P^4, 4·8; M^{1-3}, 15·1. Eight complete skins, 11 skulls and some hundreds of pelts examined.

PHASCOLOMYIDAE.

In 1929, Mr. A. S. le Souef, of Taronga Park, Sydney, drew my attention to a belief that wombats were extant in central coastal Queensland. On investigation, however, this proved to be due to the misapplication of the word wombat to *Thalacomys lagotis* in the Clermont district.

No member of this family seems to have occurred in the area in recent times.

DASYURIDAE.

In common with the *Peramelidae,* and indeed with most other small terrestrial or partly terrestrial mammals, the members of this family in the Dawson Valley underwent a sudden diminution in the late eighties of last century, and though some species have made brief recoveries from time to time, they have not persisted, and at the present time are reduced to vanishing point. The specimens reviewed in the sequel have mostly come from a small coastal area on the Fitzroy, but whether this indicates that this area has escaped the depleting influence or whether it is at present at the peak of a restoration period, I am unable to say.

The real nature of the causes underlying these declines is obscure, owing partly to the absence of reliable contemporary records covering any considerable area. In different parts of the country floods, fires, droughts, disease, and closer settlement are all confidently advanced as having been severally responsible, and

(9) Ann. Mag. Nat. Hist., ser. 9, vol. xvii., p. 635.

no doubt they have all contributed. But it is significant that the first notable diminution took place at a time when the country was still very sparsely occupied, and secondly, that the causes have been highly selective, since the *Macropodidae* and *Phalangeridae* have fluctuated within much narrower limits than the *Dasyuridae* and *Peramelidae*.

Mr. H. Barnard states that, after years of rarity, bandicoots of two species became very plentiful on Coomooboolaroo in 1895, but that in 1897 not one could be found. And again, in 1905, *D. geoffroyi (+ D. hallucatus ?)* was noticed to be suddenly numerous, but it completely vanished by 1906. The possibility of migratory waves accounting for such occurrences must not be overlooked, but although the element of *regular* periodicity is evidently lacking, there is yet something in these records suggestive of the rise and fall of the rodent populations of subarctic lands, and it may be that behind the complex of disturbing factors introduced by European settlement there is some much more fundamental cause which determines the numerical status of marsupial species at any one time. Recent experience in South Australia seems to support this idea, since two species, *Isoodon obesulus* and *Phascogale flavipes*, after 30 years of obscurity, have suddenly greatly increased in numbers in districts which are comparatively closely settled, and indeed in one case almost suburban.

Dasyurus hallucatus (Gould)

Two specimens only; one from Cooti Uti on the coast, about 100 miles north of Rockhampton, and one from the outskirts of the town itself.

I find it impossible to refer either of them with any confidence to any of Thomas's[(10)] four subspecies, and though they come from localities so little sundered and presenting similar conditions, they differ widely from one another in dimensions and colouration. Both are fully adult males taken in winter. The Cooti Uti specimen has the *typicus* colouration, but the tail is longer, very short-haired, and darkens gradually to a brownish terminus without forming a brush. Its flesh dimensions greatly exceed those of the Port Essington *typicus*, and even the large *predator* of Cape York Peninsula.

The Rockhampton specimen is smaller and much darker dorsally; the white spots on the foreback and walls of the thorax resting upon a blackish slate ground. This, however, seems to be due to a partial melanism, as an abruptly limited black area is present on the muzzle and involves the upper lip. The tail is incrassated and has the curious radish-shape characteristic of *Sarcophilus*. It is quite well furred, and the distal half is nearly black and long-haired. The tail in both specimens terminates in a small, slender, horny spur, 3 mm. long.

In manus and pes both show the characteristic striate pads of *hallucatus*, but the surrounding naked areas are not smooth but highly granular, as in *geoffroyi*. The smoothness of the palmar and plantar surfaces encircling the pads was held by Gould, Waterhouse, and Thomas (in 1888) to be a good distinction of *hallucatus* from *geoffroyi*. Pocock,[(11)] in his account of the external characters of some *dasyuridae*, does not single this character out for unequivocal mention in the text, and his figure is indefinite, nor does Thomas mention it in the subdivision of the species cited, but the evidence of these two specimens leaves no doubt that this also is a variable feature.

The skulls resemble one another very closely; that of the smaller animal being slightly the larger. In their dimensions they come nearest to the var. *predator*, of Cape York, but even if their external characters would allow it, it

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(10) Ann. Mag. Nat. Hist., ser. 9, vol. xviii. (1926), p. 543.

(11) Proc. Zool. Soc. London, 1926.

is difficult to assign them to *predator,* since Thomas's record of true *hallucatus* from Inkerman interposes another race between the two localities.

The present record extends the range of *hallucatus* on the mainland nearly 500 miles south, but in view of the great variation shown by the two examples in the restricted area from which they have come, it would be absurd, without much more material, to introduce yet more names to distinguish this southern animal from its neighbours. Most of the characters relied on by Thomas to separate the four "races" seem to be susceptible to individual, seasonal, and age variation, and with the added evidence of these two anomalous southern specimens, the conception of a single variable form extending over the coastal districts from Port Essington to Rockhampton seems to be more in harmony with the facts.

Dimensions (in alcohol) of (1) adult male from Cooti Uti and (2) adult male from Rockhampton:—Head and body, 320, 260; tail, 285, 265; pes, 48, 50; ear, 32, 36.

Skull dimensions of the same:—Basal length, 67·0, 69·2; zygomatic breadth, 40·0, 40·5; nasals, (22·2 × 10·2), (24·0 × 10·5); intertemporal, 9·4, 10·1; palate, length, 34·8, 37·0; palate, breadth inside M^2 (at ant. angle), 11·2, 12·0; ant. palatal foramina, 4·0, 4·0; basi-cranial axis, 21·2, 24·0; basi-facial axis, 40·0, 42·0; P^3, 3·0, 3·0; M^{1-3}, 12·8, 12·9.

Of the other species of *Dasyurus,* both *maculatus* and *geoffroyi* have been recorded from this portion of Queensland, and both were evidently fairly common animals until the eighties. *Maculatus* is now a very rare form, though two examples were credibly reported to have been taken in the Berserker Hills as late as 1929. *Geoffroyi* was taken on Coomooboolaroo by Lumholtz in 1884, and it may still persist there, Mr. C. Barnard having killed a native cat which he refers to this species, in the pantry of the homestead in 1930. Since *hallucatus* and *geoffroyi* may easily be confused, and as I have no specimens of the latter, I cannot record its presence in the area with any certainty.

Phascogale penicillata pirata (Thomas).

A single specimen from the Serpentine Creek, taken in mid-winter. The animal appears to be very rare on the Dawson but still has a good hold on the wetter coastal country of the Fitzroy, though it is seldom seen. Mr. Vallis informs me that he has more than once seen this animal and the local *Dasyurus* feeding at night on the carcass dumps near snaring camps, but whether the *Phascogale* is attracted thence by the carrion or its infesting larvae is a moot point. Mr. Fleay,(12) in his interesting account of this species in captivity, records his opinion that it does not eat carrion, as some of its allies certainly do. The specimen is an aged male, and I refer it to Thomas's *pirata,*(13) chiefly on the evidence of its dentition. It is distinctly, though not markedly, smaller than similarly aged males from the Mount Lofty Range of South Australia, but its smaller pes (35 : 43) is a more tangible distinction. The coat is shorter and somewhat crisper than in the south, but the general colour is not lighter, nor is the buffy sub-basal zone of the tail much more conspicuous than it frequently is in Western and South Australia.

The skull is nearly as large as that of the typical variety, and its single structural distinction seems to lie in the greater width of the nasals. I have not been able to observe the alteration in proportion of incisors and lower premolars, detected by Thomas in the Alligator River specimens, but the entire dental series

(12) Victorian Naturalist (1934), Aug., p. 89.

(13) O. Thomas. Novit. Zool. xi. (1904), p. 228.

is very markedly reduced, and the molars in particular are much slighter. Occurring in skulls of the same general size this characteristic of the teeth is a conspicuous one and, with the shorter foot, justifies the use of a trinomial for the northern animal in spite of its extraordinary external similarity to the typical form.

Dimensions of an aged male (in alcohol):—Head and body, 181; tail, 196; pes, 35; ear, 30.

Dimensions of skull of same male:—Greatest length, 48·1; basal length, 44·1; zygomatic breadth, 28·3; nasals, 18·4 × 7·8; intertemporal, 7·1; palate, length, 26·1; ant. palatal foramen, 4·1; P^4, 1·5; M^{1-3}, 8·3.

Phascogale minutissima (Gould).

Four adults and five young examined; all from the Serpentine Creek area, where apparently it is the only pouched mouse at all well known. It builds a little grass nest, frequently under logs and in termite mounds. Of the two females, one taken in April, had three naked embryos, and the other in June, was accompanied by five fully furred young with a head and body length of 50 mm. each. I have no reliable information on its distribution further south in the Dawson country.

Two distinct dorsal colourations are represented; one female with her litter of five half-grown young, having a rather cold greyish-brown tone, and the three other adults (two ♂ and ♀) a much richer reddish-brown, particularly about the head. The degree of grizzling is about the same in both and the colder tone may be an immature character. Ventrally the fur is pale buffy externally, slate basally, and there is no sign of maculation in any specimen. Gould's plate of *minutissima* seems to be misleading as to dorsal colour, as it is supposed to represent an animal stated in the text to be "brown, grizzled with black." It is much paler than any of my specimens, which are (dorsally) much nearer his plate of *maculatus*.

In foot structure and other external characters the series is constant, and with two skulls which have been extracted agree well with Thomas's description of the typical animal in the B.M. catalogue, though I have not been able to test their possible relation to his *sinualis* from Groote Eylandt by direct comparisons. From *P. ingrami brunneus* (Troughton) and *P. tenuirostris* (Troughton), the only other closely related forms which have been described from Eastern Australia, my specimens are clearly distinguished by (1) larger body size; (2) constant presence of seven sole pads with distinctly transverse striate tubercles; (3) slate and not brown underfur; (4) larger skull with greater vertical depth from basion to crown.

The largest male and female (measured in alcohol and somewhat contracted) have:—Head and body, 78, 75; tail, 55, 61; pes, 10, 10.

Skull of adult ♀:—Greatest length, 19·4; basal length, 17·9; zygomatic breadth, 10·3; nasals, 7·5 × 2·6; interorbital, 4·2; palate, length, 9·8; palate, breadth inside M^2 (at ant. angle), 3·2; P^4, 6 ca.; M^{1-3}, 3·7. Height from basion to crown, 4·8.

Sminthopsis crassicaudatus macrourus (Gould).

A single specimen, adult male, from the Serpentine Creek.

In full winter pelage this example can be exactly matched in colouration by examples from the lower wetter districts of South Australia and from Western Victoria, which themselves are not definably different in this regard from the true *crassicaudatus* of south-west Western Australia. In the Serpentine Creek specimen the dark pigmented-antero external zone of the ear is particularly well marked and, moreover, it differs from all wet country specimens I have hitherto

examined in possessing a black stripe extending with increasing width from a point 2-3 mm. short of the rhinarium, to the crown. Being bordered on either side by much lighter facial areas the mark is very conspicuous, much more so than in *crassicaudatus centralis*, where a similar though less extended feature sometimes occurs, or in *larapinta* where it is normal.(14) The tail also is longer than in any other coastal specimen I have examined.

The interdigital pads of manus and pes differ from the condition in west Victorian and lower South Australian animals in being surmounted by distinct, though small, unstriate tubercles, and the outer carpal (hypothenar) pad of the manus is shod with a large, smooth ridge more distinctly Λ-shaped than in the south.

Gould's *Podabrus macrourus*(15) was based on an animal from the Darling Downs, 400 miles south, which also possessed a well-marked median facial stripe and longer tail(16) than is usual in the south and south-west.

Although I have not examined the skull and the constancy of the characters of the foot pads remains to be ascertained, it seems advisable to retain *macrourus* provisionally as a trinomial for this north-eastern coastal representative of the species, noting however that the differences which separate it from *typicus* are much slighter than with the variety *centralis*.

S. crassicaudatus was not taken by Lumholtz in 1882-1884, nor apparently by any subsequent collector in coastal Queensland, since Longman in 1930 lists it only from south-west Queensland, where the prevailing form is the long limbed, pallid *centralis*. The present specimen, therefore, from about 28 miles north-east of Rockhampton, is a northerly record for the species on the east coast, and extends its coastal range some 400 miles.

Dimensions of adult male (in alcohol) :—Head and body, 77; tail, 71; pes, 15·5; ear, 15·0.

PERAMELES NASUTA TYPICA (Geoffroy).

Four specimens from the Serpentine Creek area where it is not uncommon, though greatly outnumbered by the local *Isoodon*. I cannot throw any light on the bionomic relations of the two genera in Queensland from personal observation, but Mr. Vallis states that whereas *Isoodon* is ubiquitous, *Perameles* is more often got in the dense growth on the slopes of the ranges. This differs from the zoning of the two genera in Tasmania, where in my experience *P. gunnii* is largely a grass or open country form, whereas *I. obesulus*, though ubiquitous, is commoner in scrubs and under heavy timber. There is, however, a great deal of overlapping, and it may be doubted whether either of the genera is decidedly adapted to any one type of habitat, as Gould thought.

In winter coat the four examples are rather more decidedly grizzled than in the examples of the New South Wales animal which have been available for comparison, and the yellow element in the colouration is rather more pronounced, but the markings of limbs, characters of appendages, and skull agree well, and the dimensions evidently vary over about the same range.

Two of the examples resemble *I. macrourus torosus* quite closely in pelage, but all can be distinguished by the narrow irregular belt of pale vinous colouration which intervenes between the grizzled sides and the white belly—evidently a constant feature in *nasuta*.

(14) In *crassicaudatus centralis* it is chiefly the coronal portion of the stripe which persists, and in *larapinta* the interorbital, but it may be quite absent from both.

(15) Proc. Zool. Soc., 1845, p. 79.

(16) Thomas, however, records an example from Queensland in which the tail is much shorter. B.M. Catalogue (1888).

Thomas's var. *pallescens* has not been examined, but is evidently a much paler and less grizzled animal than the present form.

Approximate flesh dimensions of three adult males:—Head and body, 340-416; tail, 147-173; pes, 70-77; ear, 42-46.

Skull of largest male:—Greatest length, 86·9; basal length, 78·0; zygomatic breadth, 36·8; nasals, 38·7 × 5·7; intertemporal, 13·7; palate, length, 49·6; palate, breadth inside M^2 at anterior angle, 14·1; anterior palatal foramen, 6·9; basi-cranial axis, 21·9; basi-facial axis, 56·9; P^4, 3·7; M^{s1-3}, 12·0.

Isoodon macrourus torosus (Ramsay).

Nine specimens taken in winter from a limited area in the lower Fitzroy Valley, where it is the common bandicoot of the grassy river flats and open timbered country.

From *macrourus* of the Arnhem Land littoral, it differs in the much coarser and more contrasted grizzling of the dorsal hair, but the tawny wash on throat and chest on which Ramsay relied for distinction is not a marked feature in any of the present series. Some males attain to a very large size, but both external and skull dimensions of fully adult specimens are subject to remarkably wide variation. The largest male skull, with a total length of 91 mm., shows considerably less molar wear and wider sutures than the smallest male with a total length of only 83·5 mm. There can be no question of two co-existing races, however, since the whole series is very constant in all characters save that of adult size. Similar differences are recorded by Thomas (B.M. Catalogue, 1888), a skull in the Genoa Museum (not localized by Thomas) having a basal length of 81 mm. as against 75 mm. for the type from Port Essington.

Neither the skull nor body dimensions of the type of *macrourus* are notably different from those of the smaller adult members of the present series, and measurement of larger numbers from the north coast might well disclose similar variation there. In structural features, skulls from the two districts agree closely, though the bullae in *typicus* seem to be somewhat larger than in *torosus*. For the short time that it is completely unworn, the posterior lobe of the upper M^4 in *torosus* is distinctly bicuspidate. Whether this is the origin of Thomas's cryptic remark on the "extra crook on its M^4"[(17)] I cannot determine, and no skulls of the typical form showing the tooth at the required stage are available for comparison.

The following figures give the range in dimensions of (1) four males, (2) two females, all fully adult and showing distinct facets of wear on the molars:—Head and body, 395-460; 310-410; tail, 170-215, 140-160; pes, 70-73, 60-63; ear, 36, 36.

Range in skull dimensions of (1) five males, (2) one female, all fully adult:—Greatest length (83·5-91·0), (75·3); basal length (75·0-80·4), (67·9); zygomatic breadth (36·1-40·0), (32·1); nasals, length (31·7-35·0), (31·0); nasals, greatest breadth (5·5-7·2), (4·8); intertemporal (11·1-13·0), (11·9); palate, length (49·0-54·1), (46·0); palate, breadth inside M^2 at anterior angle (13·3-16·2), (13·0); anterior palatal foramina (6·5-7·8), (6·8); basi-cranial axis (21·8-23·6), (19·6); basi-facial axis (55·1-57·2), (49·0); P^4 (3·3-3·8), (3·3); M^{s1-3} (12·5-13·9), (13·4).

Isoodon obesulus has been recorded from further north but was not taken here, and *Thalacomys lagotis* is also apparently absent, though it occurs at Epping in the Clermont district, 150 miles W.-N.-N. of the junction of the rivers.

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(17) Ann. Mag. Nat. Hist., ser. 9, vol. ix. (1922), p. 679.

Monotremata.

Ornithorhynchus anatinus (Blumenbach).

Still occasionally seen in the main channel of the Dawson and in some of its tributaries, but evidently now rare. No specimen examined.

Echidna aculeata (Shaw).

Widely spread but not plentiful. A single specimen obtained on the Fitzroy; now mislaid.

Monodelphia.

A small collection of Chiroptera was made, including the following forms:—

Pteropus scapulatus (Peters).

An enormous camp of this fruit bat was established in a mixed brigalow and softwood scrub on Coomooboolaroo in 1929. Many specimens.

Pteropus poliocephalus (Temminck).

One specimen from near Rockhampton.

Pteropus gouldi (Peters).

Two specimens from near Rockhampton.

Nyctimene tryoni (Longman).

One ♂ from Serpentine Creek.

Of *Microchiroptera* the following species were taken at various points along the Fitzroy: — *Taphozous georgianus** (Thomas), *Taphozous flaviventris* (Peters), *Eptesicus pumilus** (Gray), *Rhinolophus megaphyllus** (Gray), *Miniopterus schreibersii** (Natterer).

Of these, two specimens of *T. georgianus*, taken in mid-winter of 1932, were remarkable for the development of an enormous inguinal fat deposit.

Canis familiaris dingo (Blumenbach).

Widely spread and in the rougher parts of the country still fairly plentiful. If not persecuted, it persists in such places in the immediate vicinity of large settlements, as for example in the Berserker Hills outside Rockhampton and in the brigalow scrubs fringing the cotton settlements on the Callide Valley. In the more open cattle country it is, of course, severely discouraged by stockmen, but even so it maintains a hold on some of the oldest occupied runs in the valley. It was observed in daylight on several occasions, but no specimen taken.

Vulpes vulpes (Linnaeus) var.

The fox is a very recent intruder into the Dawson and Fitzroy country, but is now established over a large area, and though still a comparatively rare animal, is steadily gaining ground. I have no information as to the date of its first appearance on the Upper Dawson, but in the northern part of the area the first definite record is due to Mr. H. Barnard who saw it in 1917 on Rio Station, 10 miles south of the junction of the two rivers. In 1924 Mr. R. Vallis shot one on Mount Hedlow, 20 miles N.E. of Rockhampton, and since then it has been frequently taken along the Fitzroy.

Felis cattus (Linnaeus).

Numerous; particularly in scrubs and heavy timber. Judging by the refuse of its lairs, it has become almost entirely avivorous.

(*) Part of the bat collection was examined by Mr. E. le G. Troughton, who has very kindly supplied the names marked with asterisks.

Oryctolagus cuniculus (Linnaeus).

There appear to be no reliable records of the presence of the rabbit in the area, but the hare, *Lepus europeaus* var., has been taken in the Taroom district on the Upper Dawson.

Hydromys chrysogaster (Geoffroy).

Well established on nearly all the rivers, creeks and the more permanent billabongs and waterholes, but seem to be rather less plentiful than in similar stations further south.

Three specimens. ♂ and ♀ from the lagoon at Coomooboolaroo, and ♂ from a (usually) dry brigalow scrub at North Rockhampton after the flood of February, 1929.

The three skins (mid-summer) show considerable differences in colouration, but can be very closely matched by summer skins of the species from the Murray in South Australia and from the lower South-Eastern district of this State, but in view of the wide range of individual and seasonable variation which can be demonstrated in water rats from quite restricted areas, and the poor definition of the so-called races which have been named, I have not ventured, in the absence of material from North Queensland, to apply a subspecific name to the Dawson Valley representative.

The largest male from North Rockhampton has the following flesh dimensions:—Head and body, 360; tail, 265; white of tail, 145; pes, 68; ear, 20 × 11.

Skull of another male of approximately the same size:—Greatest length, 62·3; greatest breadth, 30·5; upper molar, low, 9·6.

The indigenous *Murinae* seem to be poorly represented, and with the exception of a single specimen of an apparently undescribed form, which will be dealt with elsewhere, no representatives of this group were obtained.

Mus musculus (Linnaeus) and *Rattus rattus alexandrinus* (Geoffroy) are common and widespread; the latter particularly so in the prickly pear belts, where it flourishes on the fruit, and nests in the forks of the "branches."

ACKNOWLEDGMENTS.

It is a pleasure to express my gratitude to Mr. R. Vallis, of Rockhampton, whose frequent contributions of material and data have enabled me to clear many points which would otherwise have remained obscure. The intimate knowledge which both he and his brother, Mr. C. Vallis, have of the northern part of the area treated, was freely placed at my disposal and greatly simplified my work while in the field.

For hospitality and assistance of various kinds I am also much indebted to:—Mr. Charles Barnard, of Coomooboolaroo; Mr. Harry Barnard, of Brisbane; Mr. Stewart Barrett, of Drumburle; Mr. N. H. Robertson, of Thangool; Mr. A. Gherky, of Thangool; Mr. G. Hamilton, of Dawson Vale; Mr. T. Rigby, of Cracow; Mr. G. Rigby, of Glebe; and, finally, to Mr. H. A. Longman, Director of the Queensland Museum, Brisbane.

NOTE ON THE SWARMING AND METAMORPHOSIS OF A CENTRAL AUSTRALIAN CICADA, THOPA COLORATA (DISTANT).

By H. H. Finlayson.

[Read October 11, 1934.]

In December, 1933, after a series of rains totalling 3 inches or more, which fell over the greater part of the Musgrave Range in the far north-west of South Australia, the adult of this species *(Thopa colorata)* appeared in prodigious numbers on the Ferdinand and some other creeks of the range.

Such an occurrence had not been noted before by white men who have been in that part of the country for 15 years, and though the insect is well known to the elders amongst the local blacks, men of twenty years or more were seeing the transformation of the larva into the winged form for the first time. Though I was not in a position to make extended observation or enquiry into the matter, the occurrence and its concomitants were of so spectacular a kind that many of its details were forced upon one's attention and, at the suggestion of Mr. H. Womersley who kindly identified the species, I am recording the happening together with some notes made at the time.

The observations were made at Ernabella, on the Ferdinand, in lat. 26° 17′ south and longt. 132° 10′ east, between December 30, 1933, and January 1, 1934. The transformation was taking place only along the banks of the creek, which is here lined fairly profusely with red gums *(E. rostrata)* of moderate growth. The creek had run about a fortnight before my arrival at the place, and as the cicadas had already been in evidence some days it seems likely that the circumstances are not unconnected and that an increase in the moisture content of the soil of the banks may provide the stimulus which induces the larvae to forsake their burrows, some at least of which are several feet deep.

On the morning of December 31 (a day of intense heat) the larvae were emerging in thousands from the soil and were ascending the trunks of the gums, many of which were already thickly studded with empty larval cases. Nearly all transformations which were actually seen took place on gum trunks, but evidently some days earlier in the swarming, the choice of sites had been more catholic, and much of the smaller vegetation, especially buck bush *(Salsola kali)*, here about 18 inches high, was literally smothered with cases.

The chief features of the metamorphosis seem to agree well with what has been recorded for the eastern species *Abricta curvicosta* (Germ.) and *Macrotristra angularis* (Sabr.). On emerging from the holes the larvae crawl rather aimlessly about until they encounter a tree butt by accident as it were, when they ascend to heights of from 4 to 7 feet, always working round to the shady side. The first split in the case took place on an average about 15 minutes after the larva became stationary. The intervals separating the subsequent phases of the process appear to vary considerably in different examples, and perhaps also at different times and temperatures, but the following chronological record of a single instance may be quoted.

11.50 p.m. larva stationary; 12.3, case split; 12.8, head free; 12.14, two-thirds length of cicada projecting at right angles from the case; 12.23, cicada suddenly free and superimposed on case.

In the next few minutes the pale greenish-grey creature, which is very conspicuous on the dark case, moves away with extreme deliberation to a distance of

a few inches, where it becomes perfectly quiescent except that the wings slowly unfurl—a process which occupies from 3 to 13 minutes. The black band connecting the eyes, the crescentic markings of the thorax, and the dark areas on the belly, which are undifferentiated on emergence, now slowly appear. They are distinctly visible at 25 minutes, dark brown at 40 minutes, and jet black at 60 minutes. During this period of maturation and hardening considerable loss of bulk seems to take place, and several examples were seen to expel jets of fluid at intervals, from the anus. The time of first flight was not observed, but is evidently considerably over an hour after emergence.

The numerous predators which have been noted as causing heavy mortality to cicadas do not seem to function here on any large scale. Indeed, the immunity of the soft, newly-emerged cicada from the attacks of ants was a conspicuous and interesting feature in their early history. The gum trunks were swarming with ants of at least three species—some roaming free, some travelling in file on definite routes, but in no case did I see a cicada or larva attacked, though ants were frequently within a few mm. of them. There is, however, nothing actually repellent to ants in the tissues of the cicada. A few instances were noted in which newly-emerged insects had been accidentally dislodged and had fallen, struggling, into the hot sandy soil at the foot of the tree. Here they were at once attacked by swarms of a small black *Campanotus* (?), which was quite indifferent to the stationary cicadas on the trunks.

The song of the fully-developed males, from the tree tops, seemed to be almost continuous throughout the twenty-four hours—it certainly does not stop at nightfall—but its volume fluctuated somewhat, reaching a maximum apparently in the hottest hours of midday. The noise was then overpowering, and its shrill, short-pulsing character most fatiguing. The blacks imitate the sound with great fidelity, and their name for the creature—Tcheereeree—is rather suggestive of its song.

The first lull in the uproar came in the early morning of January 1, when for two hours or more there was a strange silence, suddenly replaced by the usual din which rapidly reached its former proportions.

How far up and down the channel the swarming was taking place I was unable to determine, but in moving about the country in the weeks that followed, cicadas were heard (though not in such enormous volume as at Ernabella) at Erliwunyawunya, 40 miles west (January 3); at a camp in the Everard Range, 70 miles south (January 22); and at Oparinna, 100 miles north-west (February 3).

All these places have stands of red gums *(E. rostrata)* by semi-permanent waters, and they had all shared in the December rain, but whether there had been any flow of water near the timber cannot be stated definitely, though I think it probable.

AN ADAMELLITE FROM "THE GRANITES," NORTHERN TERRITORY.

By A. W. Kleeman, B.Sc.

[Read October 11, 1934.]

The rocks described in this paper were collected by Dr. Madigan in 1932. I am indebted to him for the specimens and the following note descriptive of the locality.

> "The granite which I have handed to Mr. Kleeman to describe became famous owing to the gold boom at 'The Granites' in 1932, which I was sent up to investigate and had the unhappy duty of condemning. The 'Granites' locality is situated in the Northern Territory of Australia in approximately Lat. 20° 47′ S. and Long. 130° 30′ E. It is 373 miles north-west of Alice Springs and 60 miles south-east of Tanami Gold Field. The area was prospected by Allan A. Davidson in 1900. He discovered gold at Tanami and at the Granites, which latter locality he referred to as Granite Hill. Rock outcrops are scarce in the region of the Granites, which is a vast level peneplain at an altitude of about 1,500 feet above sea level. The country is a sea of scrub in which are dotted about, at intervals of something like 50 miles, low islands of rock. The Granite Hill is a mass of boulders and tors with a base some two hundred yards across and rising to a height of something under a hundred feet. It is the most prominent feature within 50 miles in all directions. Half-a-mile to the north-east a schist ridge begins and runs in a long curve northerly, and then westerly, for a total distance of 5½ miles. The granite intrudes the schists and is exposed by mining operations at several points inside the curve. There are some much lower granite knolls close to the eastward, and at 43 miles east there is another low granite dome a hundred yards across, known as Thomson's Rockhole. This rock is identical in appearance with that at the Granites. The schists I consider to be of Archaean Age and the Granite to be of Mosquito Creek Age, that is Older Proterozoic."

There are two specimens from the Granites Hill. One from the north side was chosen for description and analysis as a typical specimen. The specimen from the southern side was a little coarser, but the variation is no more than is usual in a granite outcrop. A specimen from Thomson's Rockhole was also examined.

Petrographic Description of the Type Rock.

Macroscopic Features.

A grey holocrystalline rock. The mass of the specimen is fine-grained, but there are porphyritic individuals of microcline up to a centimetre in length. The minerals recognisable in hand specimens are quartz, felspar and biotite. Much of the felspar is white and opaque, but the larger microcline crystals are clear. The biotite is scattered through the rock in small flakes.

Microscopic Features.

The minerals present are as follows:—

Quartz is clear but frequently shows shadowy extinction. It is not intergrown with the felspar. The larger inclusions are rutile and apatite. Strings of inclusions can be made out to be dust and liquid. Some of the liquid inclusions have small gas bubbles in them.

Microcline is the only potash felspar in the rock. It is for the most part unaltered. The larger crystals are up to 5 mm. across and have inclusions of all the other minerals. The typical cross-hatching is well developed. Twinning on the Carlsbad Law is much less common.

Plagioclase is the dominant felspar. It has altered throughout the rock to albite and zoisite. The albite retains the crystal form and structure of the original plagioclase, but is rendered almost opaque by the minute zoisite crystals. This alteration makes the precise determination of the plagioclase difficult. The Refractive Index is above that of Canada Balsam. The maximum extinction in the zone perpendicular to 010 is about 4°, which corresponds to a composition $Ab.^{75}$ $An.^{25}$. This is only an approximation. The alteration products are indeterminate, but some few crystals larger than the rest appear to be zoisite. There does not appear to be any calcite present. This alteration seems to be due to age and some slight metamorphism.

Biotite is scattered through the rock in small flakes. It exhibits intense pleochroism, changing from light greenish-yellow to a very dark brown. Basal sections ·03 mm. in thickness are opaque. A few pleochroic haloes are observed around small zircon crystals. There is some alteration to chlorite.

Sphene forms a few subhedral crystals. It is of a brown colour with slight but noticeable pleochroism.

Apatite is not common, but is present as small rods included in the other minerals.

Zircon is seen as the core of pleochroic haloes in biotite.

Epidote is formed as an alteration product of plagioclase. It is slightly yellow and has high polarisation colours. Some crystals appear to be closer to zoisite, while the smaller crystals in the plagioclase are zoisite.

The order of crystallisation is:—(1) Biotite and Sphene, (2) Plagioclase, (3) Quartz, (4) Microcline. The large size of the microcline crystals does not seem to be due to early crystallisation, as it includes all other minerals giving a semblance of Poecilitic structure. The texture is slightly porphyritic, the groundmass allotromorphic granular. The grain size of the quartz and plagioclase lies between 0·3 mm. and 1·2 mm., the quartz tending towards the lower limit and the plagioclase towards the upper limit. The microcline ranges from about 1·0 mm. to 5 mm., the most lying between 1·0 and 2·0 mm.

The mode was obtained by the Rosiwal Method:—

Quartz - - -	34·4%	Biotite - - -	6·5%
Microcline - -	26·0%	Sphene - - -	0·5%
Plagioclase - -	32·6%		

The slide examined appeared to be too rich in quartz to be quite typical.

The specific gravity is 2·688.

The analysis of this rock was made by the writer and is as follows:—

SiO_2 (Silica) - - -	71·55	H_2O- (Water at 105°) -	0·05
TiO_2 (Titania) - - -	0·39	H_2O+ (Water above 105°) -	0·43
Al_2O_3 (Alumina) - -	15·00	P_2O_5 (Phosphoric Anhydride) -	0·19
Fe_2O_3 (Ferric Oxide) - -	·56	BaO (Baryta) - - -	Nil
FeO (Ferrous Oxide) - -	2·13	ZrO (Zirconia) - - -	0·04
MnO (Manganous Oxide) -	0·04	Cr_2O_3 (Chromium Oxide) -	Nil
MgO (Magnesia) - -	0·14	S (Sulphur) - - -	0·06
CaO (Lime) - - -	2·18		
Na_2O (Soda) - - -	3·92	Total	100·36
K_2O (Potash) - - -	3·68		

The Norm is as follows:—

Quartz	29·16	Q	29·16			
Orthoclase	21·13					
Albite	33·54			}	Salic Group	94·58
Anorthite	9·73	F	64·40			
Corundum	1·02	C	1·02			
Hypersthene (Fs)	2·77					
(En)	0·40	P	3·17			
Ilmenite	0·76					
Magnetite	0·93	M	1·69	}	Femic Group	5·41
Apatite	0·44					
Pyrites	0·11	A	0·55			
Water	0·48					

The C.I.P.W. classification of the rock is I. 4. 2. (3)4.

The Magmatic name is *Toncanose-Lassenose.*

The rock is an *Adamellite.*

According to Prof. Johannsen's proposed classification it is in group 2.2.7".

The rock from the south side is of a slightly coarser grain size, but is so essentially similar in structure and mineral composition as to render description unnecessary. The specimen from Thomson's Rockhole, though distant 43 miles from the outcrop at the Granites is again similar to the type, and there can be no doubt that the two occurrences represent but two exposures of a granite type which occurs persistently through the area.

THE MURRAY BRIDGE GRANITE.

By A. W. Kleeman, B.Sc.

[Read October 11, 1934.]

The Murray Bridge granite is seen in a number of exposures in and around Murray Bridge. The existing outcrops are exposed as a result of the River Murray cutting down into the Tertiary limestone and exposing the Old Pre-Tertiary land surface. The real extent is probably much greater than the outcrops suggest, and it is not unreasonable to suppose that the pegmatites and other igneous rocks at Rocky Gully (3 miles west of Murray Bridge) are but a phase of the same stage of intrusion. The granite may be seen in many places along the river flats near Murray Bridge. There is a very conspicuous tor near the Sturt Reserve and several less noticeable outcrops between this place and the town itself. The piers of the new Railway Bridge are all based upon a bar of granite below the muds of the river bottom. The type locality is at Swanport, about 2 miles south of Murray Bridge, where there are several outcrops. The largest outcrop has been quarried for building stones and is described in Dr. Lockhart Jack's report on "The Building Stones of South Australia"[1] as a "whaleback about 10 chains long and 2 chains wide and projecting about 25 feet above the alluvium of the Murray Flats." The stone is quarried at the eastern end of the outcrop. Here the Tertiary limestone may be seen resting upon the granite, which is weathered to a depth of about 2 inches. Stone from this quarry has been used extensively in South Australia.

The granite is very uniform over the area in which it is exposed, the only variation being a vein of aplite 4 feet wide and running in a direction N 27° E. at the western end of the Swanport outcrop, and several smaller veins only a few inches thick in the other outcrops.

Petrographic descriptions are given of both the granite and the aplite.

Petrographic Description of the Granite.

Macroscopic Features.

A coarse-grained holocrystalline rock of red colour. The minerals which can be seen in hand specimen are quartz, microcline, plagioclase, biotite, and magnetite. The quartz is in smoky grains with a vitreous lustre. The microcline (Microperthite) forms large reddish crystals which may attain a size of 2 to 3 centimetres. The plagioclase is white and rather clear. It occurs both as small crystals, 1 to 5 mm., and as zones around some of the orthoclase crystals.

The polished surface of the rock shows the relations, the large orthoclases set in in a matrix of granular quartz and plagioclase. The biotite forms smaller flakes in the quartz aggregates.

Microscopic Features.

The structure is controlled by the large perthitic microcline crystals. They appeared to have commenced crystallization at an early stage and to have attained porphyritic development before the plagioclase finished crystallizing, as many of the microcline crystals have a complete outer zone of plagioclase. On the other hand crystals which have plagioclase zones may include grains of quartz and

[1] R. Lockhart Jack, Geol. Surv. South Austr., Bull. 10, 1923, p. 70.

plagioclase. Such plagioclase as is not zoned around the microcline is associated with groups of microcline crystals. The quartz, with the biotite associated, makes up a granular matrix in which the average size of the grains is about 1 mm.

The minerals present are:—

Quartz is very abundant as clear colourless crystals. Inclusions are relatively abundant and appear to be orientated in two directions, giving the so-called rift and grain effect. Many of these inclusions, when resolved under high magnifications, can be seen to be fluid and to contain gas bubbles.

The Potash Felspar is represented by *Microcline Microperthite.* It does not show the typical grating effect of Microcline, but can be distinguished from orthoclase by the extinction which in section perpendicular to Z is 10° ($X' \wedge 001$). The grating effect can be seen in some exceptional crystals, and then only poorly developed. The intergrown plagioclase is not twinned, but it is probable that it is more sodic than the plagioclase of the rock. The albite lamellae are rather more weathered than the microcline.

The *Plagioclase* is clear and unweathered. It is twinned on Carlsbad, Albite, and Pericline laws. The individuals in the Pericline and Albite twins are thin. The maximum extinction on zone perpendicular to 010 is — 2°, which corresponds to $Ab.^{77}$ $An.^{23}$. The plagioclase mantling the microcline has the same composition, but that separating from the perthite is more sodic.

Biotite is a dark highly pleochroic variety. The pleochroism is X = light golden brown Y = Z = dark brown to opaque. Basal sections in a slide ·03 mm. thick are opaque with normal bright illumination. It is biaxial negative with a very small optic axial angle. Its properties are that of a biotite rich in iron, lepidomelane. This is borne out by the small amount of magnesia in the analysis.

Sphene is very light brown with slight pleochroism. Occurs in several large grains in the slide.

Fluorspar is usually associated with the biotite as irregular crystals with high negative relief. The presence of this mineral is a notable feature not previously recorded.

Apatite is not abundant, but some few well-shaped crystals are associated with the biotite and magnetite.

Magnetite forms a few relatively large grains.

Zircon occurs in small quantity.

The specific gravity of the rock is 2·639.

The analysis of the granite quoted below was carried out by Mr. W. S. Chapman, of the Assay Department, and is quoted in Dr. Jack's Bulletin *(op. cit.)*. The author has determined fluorine, which was not included in the original analysis:—

SiO_2 (Silica)	74·20	CO_2 (Carbon Dioxide)	0·11
TiO_2 (Titania)	0·29	P_2O_5 (Phosphoric Anhydride)	0·08
Al_2O_3 (Alumina)	14·53	FeS_2 (Ferric Disulphide)	0·10
Fe_2O_3 (Ferric Oxide)	1·14	BaO (Baryta)	Nil
FeO (Ferrous Oxide)	0·90	Cl (Chlorine)	0·03
MnO (Manganous Oxide)	0·03	F (Fluorine)	0·19
MgO (Magnesia)	0·20		
CaO (Lime)	1·00		99·71
Na_2O (Soda)	3·06	Less O for F and Cl	·09
K_2O (Potash)	3·55		
H_2O- (water at 105°C.)	0·15		99·62
H_2O+ (water above 105°C.)	0·15		

The norm is as follows:—

Quartz -	- 41·40	Q = 41·40	Salic Group = 95·40
Orthoclase -	- 21·13		
Albite - -	- 25·68		
Anorthite -	- 2·50	F = 49·31	
Corundum -	- 4·69	C = 4·69	
Hypersthene -	- 0·76	P = 0·76	Femic Group = 3·87
Ilmenite -	- 0·61		
Magnetite -	- 1·62	M = 2·23	
Apatite -	- 0·20		
Fluorite -	- 0·43		
Calcite -	- 0·25		
Pyrite - -	- 0·10	A = 0·88	
Water - -	- 0·30		

In the C.I.P.W. classification the rock is, therefore, I. 3. 1 (2). 3′. The magmatic name is *Tehamose Alaskose*.

The mode was obtained by measuring the minerals on a polished slab. Eight lines a centimetre apart and 46 centimetres long were set out and the intercept of each mineral measured. The result is as follows:—

Quartz - - -	33·8%	Biotite - - -	3·3%
Microcline Microperthite	46·0%	Magnetite - -	0·3%
Plagioclase -	16·6%		

A comparison with the norm shows that the microperthite must contain a notable percentage of the soda of the rock. The rock is a *Granite*.

According to the classification of Professor Johannsen[2] it would be called a *Leuco-Granite* 1.2.6″ P.

Petrographic Description of the Aplite.

Macroscopic Features.

The rock has a fine even-grained texture and a light pinkish-brown colour. The minerals distinguishable in hand specimen are quartz, felspar, and biotite. The quartz has a tendency toward the formation of occasional larger crystals, which have the smoky appearance seen in the quartz of the granite. The felspar is light pink in colour. Biotite is not common and collects in small aggregates.

Microscopic Features.

A fine-grained holocrystalline rock. The texture is allotriomorphic granular. The porphyritic quartz crystals can be seen with a diameter up to 3·0 mm. The grain size of the rock is by no means uniform, but the average appears to lie between 0·3 and 0·5 mm.

The minerals present are:—

Quartz is very abundant as clear colourless grains. The few inclusions occur in strings without any obvious orientation. The inclusions can be seen to be fluid, some of which contain gas bubbles. Some of the larger crystals show undulose extinction, but the majority do not.

Microcline.—Shows the usual characteristic cross-hatching. It is for the most part rather more altered than the plagioclase. It encloses grains of quartz, plagioclase, and biotite.

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(2) Johannsen, "Petrography," vol. ii., Chicago, 1932.

Plagioclase is present in approximately equal quantity with the microcline. The maximum extinction angle in zone perpendicular to 010 is 15°, which corresponds to a composition $Ab.^{95}$ $An.^{5}$. It is clear and undecomposed. There is very little intergrowth with microcline, a few plagioclase grains being included in microcline.

Biotite is strongly pleochroic, similar to that in the granite. Pleochroic haloes are not common. The biotite is altered to a slight extent to chlorite.

Fluorite is present with its characteristic high negative relief and isotropic crystals.

Magnetite is rare and is changing to haematite.

Apatite, several small crystals.

Zircon occurs in biotite sparingly, and there are one or two crystals scattered through the slide.

An analysis of this rock was carried out by the author with the following results:—

SiO_2 (Silica) - -	- 76·07	P_2O_5 (Phosphoric Anhydride) -	0·01
TiO_2 (Titania) - -	- 0·11	BaO (Baryta) - -	- Nil
Al_2O_3 (Alumina) -	- 13·96	Cr_2O_3 (Chromic Oxide)	- Nil
Fe_2O_3 (Ferric Oxide) -	- 0·14	ZrO_2 (Zirconia) - -	- Trace
FeO (Ferrous Oxide) -	- 0·42	FeS_2 (Ferric Disulphide)	- 0·13
MnO (Manganous Oxide)	- Trace	F (Fluorine) - -	- 0·10
MgO (Magnesia) -	Str. trace		
CaO (Lime) - -	- 0·68		100·41
Na_2O (Soda) - -	- 3·90	Less O. for F - -	- 0·04
K_2O (Potash) - -	- 4·64		
H_2O- (Water at 105°) -	- 0·07		100·37
H_2O+ (Water above 105°)	- 0·18		

The norm is as follows:—

Quartz -	- 34·26	Q = 34·26	
Orthoclase -	- 27·24		
Albite -	- 33·01		Salic Group = 98·82
Anorthite -	- 2·78	F = 63·03	
Corundum -	- 1·53	C = 1·53	
Hypersthene (Fs)	- 0·53	P = 0·53	
Ilmenite -	- 0·15		
Magnetite -	- 0·23	M = 0·38	Femic Group = 1·24
Fluorite -	- 0·20		
Pyrite - -	- 0·13	A = 0·33	
Water -- -	- 0·25		

In the C.I.P.W. classification the rock is I. (3)4. 1′. 3′.

The magmatic name is *Alaskose-Liparose*.

The mode was determined by the Rosiwal Method:—

Quartz -	- 33·8%	Biotite - -	- 1·2%
Microcline -	- 34·3%	Fluorspar -	- 0·4%
Plagioclase -	- 30·3%		

The Specific Gravity of the rock is 2·627.

The rock is *Granite Aplite.*

According to Johannsen's proposed classification the rock is an *Alaskite Aplite* 1.1.6″ D.

Conclusions.

The analyses of these rocks bear many points of similarity which show them to belong to the same suite. Both have little or no magnesia, a fact which is borne out by the intense pleochroism of the biotite. The aplite is very rich in silica. The quartz forms a few large smoky crystals which much resemble the quartz of the granite. These smoky crystals may have been derived from the granite by some differentiation and have been present as such in the aplite when it was intruded. Fluorine is common to both rocks, and so far has not been detected in any other South Australian granites. A noteworthy feature of the granite is the difference in composition between the calculated plagioclase (Ab 90) and the actual plagioclase Ab 80. This is due to the fact that the plagioclase of the microperthite is much less calcic than the plagioclase which has crystallized out. This appears to be connected with the zoning of the plagioclase around the perthite. There is no evidence to show why this zoning should occur.

Some attempt was made to connect these rocks with those described from Mannum area by A. R. Alderman,[3] but with little success. It is worthy of note, however, that the Aplite, when plotted on Alderman's graph, lies on the continuation of differentiation of the Tonalite-Aplite Series towards decreasing ferromagnesian constituents.

[3] A. R. Alderman, "Magmatic Differentiation of Mannum." Proc. Roy. Soc., S. Austr.

ABSTRACT OF THE PROCEEDINGS

OF THE

ROYAL SOCIETY OF SOUTH AUSTRALIA (Incorporated).

FOR THE YEAR FROM NOVEMBER 1, 1933, TO OCTOBER 31, 1934.

ORDINARY MEETING, NOVEMBER 9, 1933.

The President (Mr. J. M. Black) in the chair, and 30 members were present.

Minutes of the Annual Meeting, held October 12, 1933, were read and confirmed.

On declaring the meeting open, Mr. Black thanked the Fellows for the honour they had conferred upon him by electing him as President, and briefly referred to the important and valuable work that had been performed by the ten Presidents who had occupied the chair since the retirement of Sir Joseph Verco, after many years' service. Mr. Black then drew attention to the changes which had recently taken place on the honorary executive staff of the Society. He thanked Professor J. A. Prescott (the Immediate Past President), who was a model of ability and efficiency, for the services he had rendered during his term of office, Dr. Chas. Fenner, who had retired from the office of Treasurer, and Professor Walter Howchin, who, after more than 40 years' service, had just retired from the office of Editor. Mr. W. H. Selway then moved that the Society place on record the very valuable work that had been performed by Professor Howchin during his term as Editor. Mr. C. T. Madigan, in seconding the motion, made special reference to the sterling qualities of the Professor, and said that his regular attendance and prominent and familiar figure will be very much missed by the Fellows, and intimated that he would not, in all probability, be seen again at any of the evening meetings of the Society. The motion was supported by Professor J. Burton Cleland, and carried.

The President then called for nominations for the office of Editor, due to the retirement of Professor Howchin. Dr. L. Keith Ward nominated Dr. Chas. Fenner. The nomination was seconded by Professor J. Burton Cleland. There being no further nominations, the President declared Dr. Fenner duly elected.

Sir Douglas Mawson enquired if it was the intention of the Society to continue the practice of publishing the name of the Editor in prominent type on the title page of the Transactions and Proceedings. The President, in reply, informed Sir Douglas Mawson that the question raised would be brought under the notice of the Council.

NOMINATIONS AS FELLOWS.—Eustace Couper Black, M.B., B.S., Medical Practitioner, Magill Road, Maylands; Claude Lancelot McCloughry, B.A., A.M.I.E. (Aust.), Consulting Engineer, 271 Melbourne Street, North Adelaide.

ELECTION OF FELLOWS.—Miss Constance Margaret Eardley, B.Sc.; Miss Violet Taylor. A ballot was taken, which resulted in their election.

PAPERS—

"The Arltunga and Karoonda Meteorites," by Sir Douglas Mawson, D.Sc., B.E., F.R.S. The author gave a brief resumé of the occurrence of the fall of meteorites in different parts of the world, and then described the essential features

in connection with the meteorites described in the paper. The subject evoked a keen discussion, in which Professor J. Burton Cleland, Dr. Robt. H. Pulleine, Dr. L. Keith Ward, Dr. Chas. Fenner, and the President took part.

"Notes on Fossiliferous Cambrian near Kulpara," by T. A. Barnes, B.Sc., and A. W. Kleeman.

Exhibits—

Professor J. A. Prescott exhibited two photographs of a geological feature which appears on the Queensland Geological Map as the Great Basalt Wall. This has never been described by a geologist, although it must be one of the finest geological features in Australia. The wall is from 60 to 70 miles long, and up to 7 miles in width, the average being about 2 miles, and is from 100 to 200 feet high, and commences about 40 miles north of Charters Towers. A remarkable natural feature is that no soil occurs on the outcrop, which consists of vesicular lava, with deep cracks and caverns. Trees adjacent consist of inland scrub type.

Sir Douglas Mawson exhibited some specimens of fossil mollusca in a quartzite which has a range of about 50 feet, and is of Cambrian age, obtained along the coast south of Moana.

The President extended a welcome to Dr. and Mrs. Walkley as new members.

Ordinary Meeting, April 12, 1934.

The President (Mr. J. M. Black) in the chair, and 41 members were present.

Minutes of the Ordinary Meeting, held November 9, 1933, were read and confirmed.

An apology was received from Mr. J. H. Gosse.

The President said that it was his pleasant duty to present, on behalf of the Society, the Sir Joseph Verco Medal to Professor John Burton Cleland. Addressing the Fellows he said:—"This is the fourth occasion on which the medal has been awarded, and I think you will all agree with me that it is a fitting tribute to a great scientific career. The Professor's scientific activity is so many-sided that it is almost impossible for any one man to speak informatively upon it. Doubtless enthusiasm, which he knows how to communicate to others, and a great power of concentration upon any subject which he may take in hand, always characterises his work. Of that work I am unable to give any detailed account because much of it is entirely beyond my scope. As you all know, he has been Professor of Pathology at the Adelaide University for the past 14 years. The orbit of his activities, and of his enthusiastic activities, is a much wider one. When I became your President a few months ago, I found that I was automatically promoted to a position on the Board of Governors of the National Park. I met Professor Cleland there, and learned that he was not only a permanent member of that Board, but one of its most prominent, active, and best-informed members. The impression I have gathered is that wherever initiative is required, you can look confidently to Professor Cleland to supply that desideratum. If it were permissible to descend to slang before a gathering of the Royal Society, I would say that he is a "live wire." As regards his scientific work, I shall only refer to the section of which I have some knowledge—Botany. In the branch of that science known as Maeology Professor Cleland is, I believe, the principal authority on the larger fungi—the mushrooms, and he has described a great number of new species in our Transactions. He is also a keen investigator of our flowering plants, and as a collector of specimens, both in the settled districts, and far beyond, he is pre-eminent. You have heard one of our former Presidents, Professor T. Harvey Johnston, describe in a humorous way how, on Far Northern expeditions, the motor car became so filled with Professor Cleland's ever-

increasing collections that there remained scarcely any room for the human cargo. Of these hundreds, if not thousands, of specimens I can speak personally, for nearly all of them have passed through my hands, and I have been pleasantly impressed by the care with which they have been collected and dried. As to the local florulas of such districts as Kangaroo Island, Encounter Bay, the coastal country near Adelaide, notes as to the economic use of plants by the natives of the Far North, and of Central Australia, are not these contributions from his pen printed in the Transactions of our Society for all to read? The Professor has been a Fellow of this Society for nearly 40 years, and in 1928 he held the office of President. It was not the first time that he filled such a position, for in 1917 he was elected President of the Royal Society of N.S.W., at a time when he was the principal micro-biologist to the Department of Health in Sydney. Professor Cleland is a South Australian by birth. His father, the late Dr. William Lennox Cleland, was for many years a Fellow of this Society, and filled the office of President from 1896 to 1899. These are merely a few words to accompany the presentation of the medal. They give a very faint and inadequate idea of the work which Professor Cleland has done, and is still doing, in many branches of science. I must not trespass further on your time, but I should just like to say in conclusion, that I believe it was chiefly due to his energy and powers that the Government was induced to undertake the publication of the series of scientific handbooks dealing with our State." Mr. Black then addressed Professor Cleland, and said that it gave him the greatest pleasure in presenting to him, on behalf of the Royal Society, the Sir Joseph Verco Medal, the highest honour which is in its power to bestow.

Professor Cleland, in response, thanked the President for his kind remarks, and expressed his appreciation of the high honour conferred upon him, and said that he was gratified to receive the medal for two reasons:—First, because it was founded in honour of a very distinguished medical man—Sir Joseph Verco, who was the father of the Medical School in this State, and who played a prominent part in the University of Adelaide, and in this Society. The second reason was that he had received the medal from the hands of Mr. Black, who was a recipient of the medal himself.

The President then said:—"I should be failing in my duty if I did not again rise to tender our hearty congratulations to Professor Walter Howchin—the doyen of our Society—on the award recently made to him of the Lyell Medal by the Geological Society of London. This is no new experience for Professor Howchin, who is now, I believe, the holder of five or six medals awarded in acknowledgment of his scientific researches. I think I am correct in saying that the Lyell Medal is the highest honour which can be conferred for geological research, and it constitutes another proof that Professor Howchin enjoys not only in Australia, but a world-wide reputation in connection with that science to which he has devoted his life with such whole-souled enthusiasm.

Dr. L. Keith Ward then gave a brief resumé of Professor Howchin's distinguished scientific researches, and his valuable services as an Officer of this Society, and then moved:—"That Professor Howchin be elected an Honorary Fellow of this Society." The motion was seconded by Mr. N. B. Tindale, and carried.

The President then said that he should like, with the permission of the audience, to express the pleasure of the Fellows that another very popular and hard-working Fellow had received the degree of Doctor of Science from the University of Oxford. Dr. Madigan had worked as a geologist in many parts of the world, from the burning sands of the Soudan, to the frozen desolation of the Antarctic Continent. This degree, from one of the oldest and most celebrated of Universities, was awarded for his original work in geology, geography,

and meteorology. Dr. Madigan is quite up to date in his methods of research. He has flown over Lake Eyre, and in 1929 he surveyed from the air a waterless desert in the south-eastern part of Central Australia, consisting of many parallel rows of sandhills, which neither native or white man had been able to cross.

Election as Fellows.—E. C. Black, M.B., B.S., Medical Practitioner, Magill Road, Tranmere; E. L. McCloughry, B.E., A.M.I.E. (Aust.), Consulting Engineer, 271 Melbourne Street, North Adelaide; R. C. Shinkfield, Clerk Meteorological Bureau, West Terrace, Adelaide. A ballot was taken and the President declared them duly elected.

Papers—

"The Composition of Some Ironstone Gravels from Australian Soils," by Professor J. A. Prescott, D.Sc., A.I.C., was presented by C. S. Piper, M.Sc.

"Kinship and Descent in Australia," by H. K. Fry, D.S.O., M.B., B.S., B.Sc., D.P.H., Dipl.Anth. A keen discussion followed, in which the following took part:—Mr. A. G. Edquist, Mr. N. B. Tindale, Mr. W. H. Selway, and the President.

"The Impact of the Psychic on the Physical," by Edwin Ashby, F.L.S., M.B.O.U.

The President expressed the sympathy of the Fellows to Mr. Ashby on the serious loss he had sustained by the bush fire which had destroyed his home, and valuable Ornithological collection.

Ordinary Meeting, May 10, 1934.

The President (Mr. J. M. Black) in the chair, and 32 Members were present.

Minutes of the Ordinary Meeting, held April 12, 1934, were read and confirmed.

The President read a letter received by the Secretary from Professor Walter Howchin, in which he gratefully acknowledged the honour conferred upon him by this Society in electing him an Honorary Fellow, and intimating that as a slight token of his appreciation and thanks for the great assistance rendered to him by this Society in the publication of so many of his papers in the Proceedings, that he desired to donate the sum of £40 to the Endowment Fund, this sum being the amount (with exchange) which he had been awarded with the Lyell Medal by the Geological Society of London.

The President then informed the Fellows that Professor Howchin had recently been elected an Honorary Fellow of the Royal Society of N.S.W.

Nomination as Fellow.—John Johnston, A.S.A.S.M., Chemist, Sewage Treatment Works, 32 Fisher Street, Norwood.

Papers—

"Notes on the Aborigines of the South-East of South Australia, Part I.," by T. D. Campbell, D.D.Sc. The following Fellows took part in the discussion of the paper:—Mr. N. B. Tindale, Dr. Chas. Fenner, Dr. L. Keith Ward, and the President.

"On the Australian Species of Japygidae (Thysanura)," by H. Womersley, A.L.S., F.R.E.S.

"Single Value Climatic Factors," by Professor J. A. Prescott, D.Sc., A.I.C., was read by Dr. James Davidson. Dr. L. Keith Ward, Mr. A. G. Edquist, and the President discussed various aspects of the paper.

"The Monthly Precipitation—Evaporation Ratio in Australia as Determined by Saturation Deficit," by James Davidson, D.Sc. In the keen discussion which followed, Mr. A. G. Edquist, Dr. Chas. Fenner, and Dr. L. Keith Ward took part.

EXHIBITS—

Dr. L. Keith Ward exhibited some doubly-terminated quartz crystals which had been forwarded by Miss Mattner from a locality near Yarcowie. The tendency to form these complete crystals is always present in quartz, but the physical surroundings are seldom favourable for the development of the two complementary rhombohedra which give the pyramidal termination at each end of a crystal.

Dr. T. D. Campbell exhibited samples of oil preparations obtained from one of the tea-tree family *Melaleuca alternifolia*. Beneficial theurapeutic properties are claimed. Also the claw of *Cryptodromia octodentata* which emulated the jaws of an animal in a striking fashion.

ORDINARY MEETING, JUNE 14, 1934.

The President (Mr. J. M. Black) in the chair, and 23 members were present.

Apologies were received from Dr. L. Keith Ward and Dr. Chas. Fenner.

Minutes of the Ordinary Meeting, held May 10, 1934, were read and confirmed.

NOMINATION AS FELLOW.—Rev. H. A. Gunter, Minister of Religion, 33 Kensington Terrace, Norwood, was read.

ELECTION AS FELLOW.—John Johnston, A.S.A.S.M., Chemist, Sewage Treatment Works, 32 Fisher Street, Norwood.

The President extended a welcome to Mr. R. C. Shinkfield as a new Fellow of the Society.

EXHIBITS—

Sir Douglas Mawson exhibited:

(a) Cryptozoön limestone resembling that already recorded from the MacDonnell Ranges and from the North Flinders Range, but obtained from a new locality in the Southern Flinders Range near Eurelia. The new records are of the same vertical columnar form common in the Pre-Cambrian and Cambrian rocks of the other localities mentioned. Its association with coarse oolitic limestone is similar to that found in the late Pre-Cambrian of the North Flinders Range. Its stratigraphical position appears to be that of the Brighton limestone horizon.

(b) A portable collection of some of the leading chemical elements.

Mr. H. H. Finlayson, in exhibiting specimens of Mastacomys fiscus, stated that they formed part of a series taken by him in Cradle Valley, N.-W. Tasmania in 1931, and were the first examples of the animal to be obtained since the British Museum acquired the unique type specimen in 1852. He pointed out some distinctive features in the dentition of the animal, and drew attention to its convergent similarity to some voles of the subfamily Microtinae of the Northern Hemisphere.

Mr. E. H. Ising exhibited a number of specimens of native plants collected at McDonald Station, 150 miles north-east from Alice Springs. The shrub and tree vegetation on the hills, ranges, and flats were fairly plentiful and at times thick and dense. The ground flora is plentiful after the March rains, but at the time of the visit, August and September, 1933, it was rather sparse. In the sandhill country the plant life was very different, having an interesting suite of plants of its own. Among the species shown was the following:—*Grevillea*, sp., a tall shrub with golden flowers; *Erythrina vespertilio*, a bean tree with scarlet seeds; several mallees, including *Eucalyptus gamophylla* and *E. pachyphylla*, and *Newcastlia cephalantha*, a rare verbenaceous plant. These are from the sandhill country. The following grow on the ranges or flats:—*Fiscus platypoda*, a fig growing amongst rocks; *Grevillea* and *Hakea* opp.; *Loranthus gibberulus*, a

mistletoe; *Acacia spondylophylla,* a wattle giving off a scent, like curry; *Vertilago viminatis,* supple jack, a good sheep fodder; *Brununia australis,* the beautiful pin-cushion plant which is also found in our hills; *narodenia australis,* native pear, "Alungwa" of the Illiaura tribe, and the young fruits and leaves are eaten by them.

Dr. W. Christie exhibited a fungus from Halidon similar to those shown by Professor Cleland. One specimen showed fluorescence at the tips when placed under the ultra-violet lamp. He asked members for information concerning the nature of the fungus, and also for information as to his second exhibit. This consisted of a group of hollow structures of varying sizes, and probably of organic origin, which came from Elliston, and whose walls were calcified. They are locally known as "Rabbit eggs," or "Fairy slippers." They are found on Flinders Island, as well as on the coast.

Professor J. Burton Cleland showed portion of a karri sleeper from Halidon, near Alawoona, disintegrated by a fungus which appeared to be a new species of *Lentinus.* This fungus permeates the wood and then transfers the food materials absorbed into large digitate sclerotia, some as big as a child's head, the finger-like processes pointing downwards in the ground. Eventually all the nourishment is transferred from the wood to the sclerotium. A rotting sleeper was dug up and replanted in sand adjacent to the railway line, and it produced a fruiting body from the upper surface of the sclerotium after the first autumn rains. He also showed a very large false sclerotium weighing 17 lbs. 2 ozs., which bore the fruiting body of *Polyporus basilapiloides.* The food materials in the sclerotium had been extracted from a piece of rotten wood.

Dr. T. D. Campbell exhibited three sets of plaster models made from impressions of the dental arches and palates of three young adult male aborigines. They illustrated the very fine jaw development among these people. Models of well-formed modern white jaws were also shown for comparison. Two partly-formed upper incisor crowns from the skull fragments of an Australian Aboriginal infant were exhibited as examples of striking width of incisor tooth crowns.

Professor T. Harvey Johnston exhibited a large angler fish or frog fish *Rhyncherus filamentosus,* caught by Mr. S. How at Port Willunga. The species is characterised by its wide black and white bars or blotches, its smooth skin bearing abundant soft processes, its short stalked eye, and its long "fishing rod" with a bifurcate "lure." Also a minute frog fish taken off the Tasmanian coast, and a quantity of otoliths of the mulloway, taken from an aboriginal midden on a sand dune to the north of Port Willunga. There were also some fragments of human skeleton present.

Mr N. B. Tindale exhibited a series of Hepialid moths, *Oxycanus diremptus* Walk, from Moe, Victoria. Mr. C. G. L. Gooding recently noticed freshly-emerged moths being eaten by frogs, and on request forwarded a series of the predators, which prove to be two species of tree frogs *(Hyla)* and *Limnodynastes dorsalis.* The moths feed upon the roots of the Cootamundra wattle (Acacia Baileyana) and emerge in April, usually during or shortly after rain, and at such times a fair percentage may be destroyed by the frogs.

Mr. H. Womersley exhibited moths and larva of three species of hawk moths *(Sphingidae),* the vine hawk moth *(Deilephila celerio),* always common. The silver-striped hawk moth, fairly common, in the more northern and drier parts of the State, but seldom seen near Adelaide, a young larva taken near Adelaide was shown. Convalienlees hawk moth, which this year has been fairly common around Adelaide, many larva having been brought to the Museum.

The President exhibited two specimens of *Nicotiana Gossei,* one being a flowering branch taken from a plant four feet high growing in his garden from seed obtained by Professor Cleland in Central Australia, and the other a young

plant. Mr. Black mentioned that a revision of Australian Nicotianas has been undertaken by Professor Goodspeir at the University of California.

Ordinary Meeting, July 12, 1934.

The President (Mr. J. M. Black) in the chair, and 28 members were present.

Minutes of the Ordinary Meeting, held June 14, 1934, were read and confirmed.

Apologies were received from Dr. L. Keith Ward and the Secretary.

Election of Fellow.—Rev. H. A. Gunter, Minister of Religion, 33 Kensington Terrace, Norwood. A ballot was taken, and the President declared the Rev. Gunter elected.

The President referred to the appointment of Dr. J. G. Wood as Professor of Botany at the University of Adelaide. It was agreed that a letter conveying the congratulations of the Society be sent to Dr. Wood.

The Rev. N. H. Louwyck presented to the Society, on behalf of Lady Petrie, two volumes of "Ancient Egypt."

Papers—

"Australian Australites, Part I., Classification of the W. H. C. Shaw Collection," by Chas. Fenner, D.Sc. The paper was illustrated with lantern slides. Sir Douglas Mawson and Professor Kerr Grant took part in the discussion of the paper.

"The Blue-Metal Limestone and its Associated Beds," by T. A. Barnes, B.Sc., and A. W. Kleeman. Sir Douglas Mawson and Dr. C. T. Madigan discussed various points in the paper.

Exhibits—

Sir Douglas Mawson exhibited Tectites collected by Professor La Croix in French Indo-China, which are more regular in shape than Australites, but are of the same chemical composition.

Dr. Robt. H. Pulleine exhibited some primitive implements found near Otago, New Zealand, by Professor Skinner. The piece of green stone was probably used for carving.

Mr. Percy Ifould exhibited some large pieces of compact Tertiary limestone obtained from a road cutting between Tailem Bend and Moorlands which were lying on the surface of the ground, and without any covering of travertine. There was also a good exposure of diorite close by.

Ordinary Meeting, August 9, 1934.

The President (Mr. J. M. Black) in the chair, and 17 members were present.

An apology was received from Dr. L. Keith Ward.

Minutes of the Ordinary Meeting, held July 12, 1934, were read and confirmed.

Papers—

"A Preliminary Account of the Collembola-Arthropleona of Australia, Part II., Superfamily Entomobryoidea," by H. Womersley, F.R.E.S., A.L.S. The paper was discussed by Professor T. Harvey Johnston, Mr. W. J. Kimber, Mr. D. C. Swan, Dr. Chas. Fenner, and the President.

Exhibits—

Dr. Chas. Fenner exhibited five specimens obtained from Mr. H. R. Adamson, of the Mutooroo Pastoral Company. They originally came from the collection made many years ago by Mr. M. B. Ive, who was the General Manager of the Beltana Pastoral Company. The largest specimen consists of sedimentary rock containing large shells which appear to be *Maccoyella* and others. This

specimen probably came from Murnpeowie. The second specimen is a hammer or pestle, consisting of a water-worn pebble attached to portion of a siliceous matrix. This probably came from Wooltana. It has apparently been shaped and used by the aborigines. The third specimen is a silicified ferruginous concretion, and the remaining two specimens appear to be siliceous concretions that have been carried and handled a great deal by aborigines, possibly as ceremonial objects (Murnpeowie). Dr. T. D. Campbell agreed with the suggestion made by Dr. Fenner that the siliceous concretions had probably been handled and carried by aborigines.

Mr. W. J. Kimber exhibited some fossil cephalopods which had been collected from the lower Tertiary beds at the base of the high cliffs north of the jetty at Port Noarlunga in January, 1934, and said that he was fortunate in securing, after careful digging, a fine specimen of the Nautiloid fossil *Aturia Australis* McCoy. This closely resembles *Aturia aturi,* Basterot, found in France and Italy, and also *Aturia ziczac,* Sowerby, of the London clays. Mr. Frederick Chapman, of Melbourne, secured a specimen of *Aturia aturi* from France, and compared it with a representative number of fossils taken in New Zealand, Victoria, and South Australia, and decided that the Australian species was different, and gave it the specific name, Australis. A large specimen exhibited also came from Port Noarlunga. Also two specimens of *Nautilus felix* Chapman (?) The type of this species came from Happy Valley, South Australia. A small fracture in the shell exposes the wonderful chambers similar to those now made by the recent *Nautilus pompilius.* The siphuncle and chambers are covered with crystals.

Mr. J. K. Taylor exhibited a stereoscope possessing some distinct features, and some stereoscopic photographs of the Berri Irrigation areas.

Ordinary Meeting, September 13, 1934.

The President (Mr. J. M. Black) in the chair, and 24 members and visitors were present.

Minutes of the Ordinary Meeting, held August 9, 1934, were read and confirmed.

The President referred to the loss to science by the death of Professor Sir T. W. Edgeworth David, who was an Honorary Fellow of this Society, and Emeritus Professor of Geology at the University of Sydney, and invited Dr. L. Keith Ward to pass on some references and history of Sir Edgeworth David. Dr. Ward then referred to the distinguished career of Sir Edgeworth David, who had been an Honorary Fellow of the Royal Society of South Australia since 1897. Honours had been heaped upon him—by His Majesty the King, and by many Universities and Scientific Societies. He had been closely associated with the administration of the University of Sydney, where he was appointed to the chair of Geology in 1891; of the Association for the Advancement of Science, of which he was twice President; with the Australian Research Council; of the Linnaean Society of New South Wales; of the Royal Society of New South Wales; and of the Australian Museum.

Sir Edgeworth David had taken a leading part also in expeditions to Funafuti on the equator, and to Antarctica. He had visited very many parts of Australia and had made very numerous contributions to our knowledge of the geology of the Commonwealth, particularly in regard to glaciology, stratigraphy, and structural geology, but extending also into petrology and palaeontology.

Apart altogether from his strictly scientific work, Sir Edgeworth David had exercised an extraordinary influence through his power to inspire others and to imbue them with the spirit of research. His gift of eloquence made him much sought after as a public lecturer, so much so that his friends feared many times that he was overtaxing his reserves of strength.

There are very many in Adelaide who will mourn his loss, and none to a greater degree than the Fellows of this Society who, on many occasions, have listened to his expositions.

Dr. Ward then moved:—"That this Society records its deep sense of loss at the death of Sir Edgeworth David who has been an Honorary Fellow of the Society since 1897, and extends its sincerest sympathy to Lady David and the other members of his family. The motion was seconded by Professor T. Harvey Johnston, who paid a tribute to one who had been greatly instrumental in assisting him to follow a scientific career, and with eulogistic remarks endorsed the sentiments expressed by Dr. L. Keith Ward. The motion was supported by Mr. W. H. Selway, and carried by the Members standing.

The President extended a welcome to the Rev. H. A. Gunter and Mr. John Johnstone as new Fellows of the Society, and then welcomed as visitors Mr. Rait (an Entomologist from Canberra), Mrs. Evans (a daughter of Dr. Tillyard, Entomologist, Canberra), and Mr. Wm. Goodhart.

Nomination as Fellow.—Wm. Woide Goodhart, 7 Harrow Road, St. Peters.

Papers—

"Some Australian Anaporrhutine Trematodes," by Professor T. Harvey Johnston, M A., D.Sc

"A Revision of the Ipoinea (Homoptera Eurymelidae)," by J. W. Evans, M.A., F.R.E.S

Exhibits—

Professor J. Burton Cleland exhibited specimens of *Mesembrianthemum (carpobrotus) alquilatems* with the usual purplish-red flowers and also white; *M. (c.) Pullcinei,* a new locality; *M. (Disphyma) australe;* and the *ascledial sarcostemma australe* unusually far south—all collected by Pastor C. Hoff, Emu Downs, via Eudunda.

Also the small fruits of *Cucumis chate,* eaten by the natives from Pandic Pandic on the Diamantina; and a flowering specimen of a species of *Polygonum,* new for the State, growing in mud in the same locality and producing a growth nearly the height of a man, the pith of the stems being eaten by the natives after roasting in hot ashes.

Annual Meeting, October 11, 1934.

The President (Mr. J. M. Black) in the chair, and 29 Members and visitors were present.

Minutes of the Ordinary Meeting, held September 13, 1934, were read and confirmed.

Apologies were received from His Excellency the Governor, and Dr. James Davidson.

The President extended a welcome to Mr. George Aiston, of New Well Station, Mulka, Central Australia

The President informed the Fellows that His Excellency the Governor, Major-General Sir Winston Joseph Dugan, K.C.M.G., C.B., D.S.O., had graciously consented to act as Patron of the Society during his stay in South Australia.

The Annual Report of the Council for the year 1933-34 was presented by the Secretary.

The Financial Statement and Balance-sheet was presented by the Treasurer, who then moved that it be received and adopted. The motion was seconded by Dr. T. D. Campbell and carried.

Dr. Wm. Christie then moved a vote of thanks to the Auditors for their valuable assistance and services they had rendered to the Society. The vote of thanks was seconded by Dr. Chas. Fenner, and carried.

ELECTION OF OFFICERS FOR THE YEAR 1934-35.—The following nominations for office-bearers were received, and then declared elected by the President:—PRESIDENT, T. D. Campbell, D.D.Sc.; SENIOR VICE-PRESIDENT, C. T. Madigan, M.A., B.E., D.Sc.; JUNIOR VICE-PRESIDENT, Herbert M. Hale; SECRETARY, Ralph W. Segnit, M.A., B.Sc.; TREASURER, Wm. Christie, M.B., B.S.; EDITOR, Chas. A. E. Fenner, D.Sc.; MEMBERS OF COUNCIL, Professor J. Burton Cleland, M.D., and E. H. Ising; AUDITORS, W. C. Hackett and O. A. Glastonbury.

The Immediate Past President (Mr. J. M. Black) extended his congratulations to his successor in office, Dr. T. D. Campbell, and then moved a vote of thanks to the executive officers of the Society. Their important duties were performed without any other reward than a consciousness of work well done. Mr. Ralph Segnit had served as Hon. Secretary for four years, and it was largely due to his assiduity and enthusiasm that the affairs of the Society ran so smoothly. On Dr. Charles Fenner had fallen the mantle from the shoulders of their dear old friend, Professor Walter Howchin, who had for so many years edited the Transactions and Proceedings of the Society. Their new editor, well known to the scientific world through his publications on the physiography and ethnography of South Australia, possessed all the scholarly attributes which the position demanded. Dr. Christie had for the past year ably filled the office of Hon. Treasurer of the Society, and it was to be hoped that he would for many years continue to do so. Sir Douglas Mawson, who seconded the proposal, also expressed his high appreciation of the services which the executive officers had rendered during the preceding year. The motion was carried by acclamation.

The question of "National Monuments" was then introduced for discussion and consideration of the Fellows by Sir Douglas Mawson, with the view to the matter being brought forward at the next meeting of the Australian and New Zealand Association for the Advancement of Science. Sir Douglas Mawson outlined the history of, and the disappointment felt at, the inactivity displayed by the Commonwealth Government in making the Henbury Craters a closed reserve, and referred to other monuments such as caves inhabited by aborigines, and places where native carvings were being destroyed and removed, which should also be preserved by some Act, and then moved: "That the Delegates from this Society to the Australian and New Zealand Association for the Advancement of Science be empowered to bring forward the question for consideration and action at the next meeting." The motion was seconded by Mr. N. B. Tindale, and carried.

PAPERS—

Additions to the Flora of South Australia, No. 32, by J. M. Black, A.L.S.

The Munyallina Beds.—A Late Proterozoic Formation, by Sir Douglas Mawson, D.Sc., F.R.S.

Climate in Relation to Insect Ecology in Australia: 1. Mean Monthly Precipitation and Atmospheric Saturation Deficit in Australia, by James Davidson, D.Sc.

Australian Fungi; Notes and Descriptions, No. 10, by J. Burton Cleland, M.D.

Notes on the Flora of S.A., No. 3, by E. H. Ising.

On Mammals from the Dawson and Fitzroy Valleys, Central Coastal Queensland, by H. H. Finlayson.

Notes on the Swarming and Metamorphoses of a Central Australian Cicada, Thopa colorata (Distant), by H. H. Finlayson.

The Murray Bridge Granite, by A. W. Kleeman, B.Sc.

The Adamellite from the Granites, Northern Territory, by A. W. Kleeman, B.Sc.

Dr. Wm. Christie then moved a vote of thanks to the Chairman (Mr. J. M. Black) for the services he had rendered the Society during the period he had acted as a Member of the Council, and especially during the past year as President. The motion was seconded by Dr. T. D. Campbell, and carried.

ANNUAL REPORT.

PRESENTED AT THE ANNUAL MEETING ON OCTOBER 11, 1934.

The average attendance of Fellows at the meetings held during the year has been 27.

The office of Patron of the Society became vacant during the year owing to the departure from the State of His Excellency the Governor, Brig.-General the Hon. Sir A. G. A. Hore-Ruthven, V.C., K.C.M.G., C.B., D.S.O.

His Excellency, Major-General Sir Winston Joseph Dugan, K.C.M.G., C.B., D.S.O., Governor of South Australia, has graciously consented to act as Patron of the Society.

At the meeting held in April, the President presented to Professor J. Burton Cleland the Sir Joseph Verco Medal.

Professor Walter Howchin was elected an Honorary Fellow of this Society in recognition of his distinguished researches and valuable services as an Officer of the Society. He was also elected an Honorary Fellow of the Royal Society of New South Wales.

Dr. C. T. Madigan, a Vice-President of the Society, had the distinguished honour of the degree of Doctor of Science conferred upon him by the University of Oxford.

Professor Walter Howchin received the congratulations of the Society on having been awarded the Lyell Medal by the Geological Society of London.

Dr. J. G. Wood received the congratulations of the Society on his appointment to the Chair of Botany at the University of Adelaide.

Professor Walter Howchin resigned from the office of Editor of the Annual Transactions and Proceedings of the Society, which office he had filled with distinction for more than 40 years.

Dr. Chas. A. E. Fenner was elected to the office of Editor, on the retirement of Professor Walter Howchin.

Dr. T. D. Campbell, a Vice-President of the Society, was re-elected as the Society Representative on the Board of Governors of the Public Library, Museum, and Art Gallery, and resigned from that office in July. Professor Sir Douglas Mawson was elected to fill the vacancy on the Board for the remainder of the year.

Professor J. G. Wood was elected as the Representative Member of this Society on the Fauna and Flora Board to fill the vacancy caused by the death of Mr. M. S. Hawker.

At the Ordinary Meeting held in May, the President announced that Professor Walter Howchin had donated the sum of £40 to the Endowment Fund of this Society.

Professor J. A. Prescott was elected as the Representative Delegate of this Society to the Centenary Celebrations of the Geological Society of Edinburgh.

Dr. B. G. Maegraith and Dr. A. J. Lewis were elected as Delegates from this Society to the International Congress of Anthropological and Ethnological Sciences held in London from July 30 to August 4, 1934.

Dr. Chas A. E. Fenner and Dr. T. D. Campbell were elected as Delegates from this Society to the meeting of the A.N.Z.A.A.S., to be held in Melbourne in 1935.

The following Fellows of this Society took part in the Adelaide University and Museum Anthropological Expedition to Central Australia:—Dr. T. D. Campbell (Leader), Professor J. Burton Cleland, Professor T. Harvey Johnston, Dr. H. K. Fry, and Mr. N. B. Tindale.

During the year the Council gave consideration to the question of obtaining additional space in the crypt for the expansion of the Library, and to the matter of obtaining a new lantern and episcope for the use of the Society and Scientific bodies using the Society rooms.

The Ordinary Meeting of the Society, held in June, was devoted to Exhibits.

Papers.—Botanical papers were read by Mr. J. M. Black, Professor J. Burton Cleland, and Mr. E. H. Ising.

Geological papers were read by Professor Sir Douglas Mawson, Dr. Chas. Fenner, Mr. A. W. Kleeman, and two conjoint papers by Messrs. T. A. Barnes and A. W. Kleeman.

A Soil Survey paper was presented by Dr. James Davidson on behalf of Professor J. A. Prescott.

Anthropological papers were read by Dr. T. D. Campbell and Dr. H. K. Fry.

Two Entomological papers were read by Mr. H. Womersley, and one by Mr. J. W. Evans.

A Zoological paper was presented by Professor T. Harvey Johnston.

Papers on Climatology were read by Professor J. A. Prescott, and two by Dr. James Davidson.

A Physical paper was read by Mr. Edwin Ashby.

During the year the Society has suffered loss by death of Professor Sir Edgeworth David, an Honorary Fellow of the Society, who died in August. An Obituary Notice appears elsewhere in this volume.

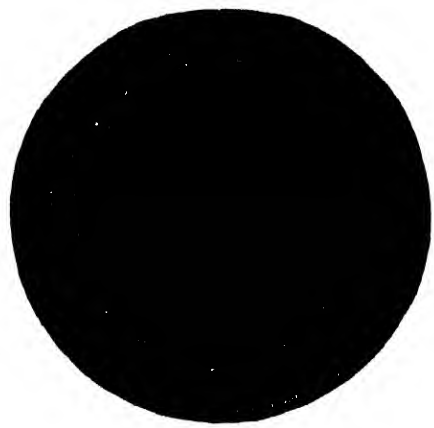
The membership of the Society shows an increase. The number of Fellows elected during the year being 8. Three Fellows resigned, and one died. The Membership Roll at the close of the financial year is:—Honorary Fellows, 4; Fellows, 171; Associate, 1. Total, 176.

J. M. Black, *President.*

Ralph W. Segnit, *Secretary.*

THE SIR JOSEPH VERCO MEDAL.

The Council, on August 23, 1928, having resolved to recommend to the Fellows of the Society that a medal should be founded to give honorary distinction for scientific research, and that it should be designated the Sir Joseph Verco



Medal, was submitted to the Society at the evening meeting of October 11, 1928, and at a later meeting, held on November 8, 1928, when the recommendation of the Council was confirmed on the following terms:—

Regulations.

XI.—"The medal shall be of bronze, and shall be known as the Sir Joseph Verco Medal, in recognition of the important service that gentleman has rendered to the Royal Society of South Australia. On the obverse side of the medal shall be these words: 'The Sir Joseph Verco Medal of the Royal Society of South Australia,' surrounding the modelled portrait of Sir Joseph Verco, while on the reverse side of the medal there shall be a surrounding wreath of eucalypt, with the words: 'Awarded to .... for Research in Science,' the name of the recipient, and the year of the award. The Council shall select the person to whom it is suggested that the medal shall be awarded, and that name shall be submitted to the Fellows at an Ordinary Meeting to confirm, or otherwise, the selection of the Council, by ballot or show of hands. The medal shall be awarded for distinguished scientific work published by a Member of the Royal Society of South Australia."

Awards.

1929 Prof. Walter Howchin, F.G.S.
1930 John McC. Black.
1931 Prof. Sir Douglas Mawson, B.E., D.Sc., F.R.S.
1933 Prof. J. Burton Cleland, M.D.

ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED).

Receipts and Payments for the Year ended September 30, 1934.

RECEIPTS.

	£ s. d.	£ s. d.
To Balance, October 1, 1933		744 3 7
„ Subscriptions		131 8 0
„ Use of Room by other Societies	9 4 0	
„ Sale of Publications	6 19 7	
„ Exchange, etc.	0 3 0	
		16 6 7
„ Endowment Fund (Contra)—		
Professor Walter Howchin	40 0 0	
Anonymous Donation	5 5 0	
		45 5 0
„ Interest—		
Savings Bank Account	19 0 0	
Transferred from Endowment Fund	149 1 2	
		168 1 2
		£1,105 4 4

PAYMENTS.

	£ s. d.	£ s. d.	£ s. d.
By Transactions—			
Printing		233 9 4	
Illustrating		26 1 6	
Publishing		5 0 9	
			264 11 7
„ Library—			
Librarian		40 12 6	
Cartage on Books		0 16 11	
			41 9 5
„ Sundries—			
Cleaning and Lighting		10 1 3	
Printing, Postages and Stationery		28 4 4	
Petties		3 15 0	
Insurance		6 15 0	
Cheque Book and Bank Fee		0 10 0	
Projector Repairs		2 12 6	
			51 18 1
„ Research Fund			20 0 0
„ Endowment Fund (Contra)			45 5 0
„ Balance, September 30, 1934—			
Savings Bank of S.A.		613 12 8	
Bank of Australasia	£72 7 7		
Less Outstanding Cheques	4 0 0		
		68 7 7	
			682 0 3
			£1,105 4 4

W. CHRISTIE, Hon. Treasurer.

Audited and found correct,

W. CHAMPION HACKETT } Hon.
O. GLASTONBURY, A.A.I.S., A.F.I.A. } Auditors.

Adelaide, October 9, 1934.

ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED).

(a) ENDOWMENT FUND as at September 30, 1934.

(Capital . .. £4,331 18 7d.)

	£ s. d.	£ s. d.
1933—October 1.		
To Balance—		
Australian Consolidated Stock ...	4,280 0 0	
Savings Bank of S.A.	6 13 7	
		4,286 13 7
„ Professor Walter Howchin, F.G.S. ...	40 0 0	
„ Anonymous Donation	5 5 0	
		45 5 0
„ Interest Received		149 1 2
		£4,480 19 9

	£ s. d.	£ s. d.
1934—September 30.		
By Revenue Account		149 1 2
„ Australian Consolidated Stock Face Value	280 0 0	
„ Savings Bank Account	46 13 7	
„ Bank of Australasia	5 5 0	
		4,331 18 7
		£4,480 19 9

(b) RESEARCH FUND as at September 30, 1934.

	£ s. d.	£ s. d.
1934.		
March 24—To General Revenue	10 0 0	
June 6— „ „ „	10 0 0	
		20 0 0
		£20 0 0

	£ s. d.	£ s. d.
1934.		
Sept. 30—By Grants in Aid of Research Work—		
H. H. Finlayson ..	10 0 0	
T. H. Colquhoun	5 0 0	
		15 0 0
„ Balance—		
Savings Bank of S.A. ..		5 0 0
		£20 0 0

Audited and found correct. We have verified the Government Stocks at the Registries of Inscribed Stock, Adelaide.

W. CHAMPION HACKETT
O. GLASTONBURY, A.A.I.S., A.F.I.A. } Hon. Auditors.

W. CHRISTIE, Hon. Treasurer.

Adelaide, October 9. 1934.

THE ENDOWMENT FUND.

1902.—On the motion of the late Samuel Dixon it was resolved that steps be taken for the incorporation of the Society and the establishment of an Endowment and Scientific Research Fund. Vol. xxvi., pp. 327-8.

1903.—The incorporation of the Society was duly effected and announced. Vol. xxvii., pp. 314-5.

1905.—The President (Dr. J. C. Verco) offered to give £1,000 to the Fund on certain conditions. Vol. xxix., p. 339.

1929.—The following are particulars of the contributions received and other sources of revenue in support of the Fund up to date:—

SUMMARY OF THE ENDOWMENT FUND (30/8/34).

(Capital £4,331 18s. 7d.)

	£	s.	d.	£	s.	d.	£	s.	d.
Donations—									
1908, Dr. J. C. Verco ...	1,000	0	0						
1908, Thomas Scarfe	1,000	0	0						
1911, Dr. Verco	150	0	0						
1913, Dr. Verco	120	0	0						
Mrs. Ellen Peterswald ...	100	0	0						
1934, Prof. Walter Howchin, F.G.S. . . .	40	0	0						
"Anonymous"	5	5	0						
Small Sums	6	0	0						
				2,421	5	0			
Bequests—									
1917, R. Barr Smith	1,005	16	8						
1920, Sir Edwin Smith	200	0	0						
				1,205	16	8			
Life Members' Subscriptions ..				225	0	0			
							3,852	1	8
Total Subscribed Capital							£3,852	1	8

Additions from the Current Account have been made at various dates. These have enabled the Society to purchase Government Stocks amounting to (face value) £4,280. Cash in hand on account of the Endowment Fund amounts to £51 18s. 7d. The total capital of this Fund is, therefore, £4,331 18s. 7d.

GRANTS MADE IN AID OF SCIENTIFIC RESEARCH.

	£	s.	d.
1916, G. H. Hardy, "Investigations into the Flight of Birds" ..	15	0	0
1916, Miss H. A. Rennie, "Biology of *Lobelia gibbosa*"	2	2	0
1921. H. R. Marston, "Possibility of obtaining from Azine precipitate samples of pure Proteolytic Enzymes" .	30	0	0
1921, Prof. Wood Jones, "Investigations of the Fauna and Flora of Nuyts Archipelago"	44	16	7
1934. H. H. Finlayson, "Mammals of Central Australia" ..	10	0	0
1934. T. T. Colquhoun, M.Sc., "Regeneration of Vegetation after Bush-fires"	5	0	0

W. CHRISTIE, Hon. Treasurer.

ROYAL SOCIETY LIBRARY.

List of Governments, Societies and Editors with whom Exchanges of Publications are made.

AUSTRALIA.

Australasian Institute of Mining and Metallurgy, Melbourne.
Bureau of Census and Statistics, Canberra.
Council for Scientific and Industrial Research, Melbourne.
Library of Commonwealth Parliament.

SOUTH AUSTRALIA.

Botanic Garden, Adelaide.
Mines Department, Adelaide.
Public Library, Museum, and Art Gallery of South Australia.
Royal Geographical Society of Australasia (S.A. Branch).
South Australian Institutes Association, Adelaide.
South Australian Museum, Adelaide.
South Australian Naturalist, Adelaide.
South Australian Ornithologist, Adelaide.
South Australian Parliamentary Library.
University of Adelaide.
Waite Agricultural Research Institute, Glen Osmond.

NEW SOUTH WALES.

Australian Museum, Sydney.
Botanic Gardens, Sydney.
Department of Agriculture, Sydney.
Linnean Society of New South Wales.
Mines Department, Sydney.
Public Library of New South Wales.
Royal Society of New South Wales.
Royal Zoological Society of New South Wales.
School of Public Health and Tropical Medicine, Sydney
Technological Museum, Sydney.
University of Sydney.

QUEENSLAND.

Department of Agriculture, Brisbane.
Geological Survey, Brisbane.
Queensland Museum, Brisbane.
Public Library of Queensland, Brisbane.
Royal Society of Queensland, Brisbane.
University of Queensland, Brisbane.

TASMANIA.

Government Geologist, Mines Department, Hobart.
Public Library of Tasmania, Hobart.
Royal Society of Tasmania, Hobart.
University of Tasmania, Hobart.

VICTORIA.

Field Naturalists' Club of Victoria, Melbourne.
Government Botanist, National Herbarium, Melbourne.
Mines Department, Melbourne.
National Museum, Melbourne.
Public Library of Victoria, Melbourne.
Royal Society of Victoria, Melbourne.
University of Melbourne.

WESTERN AUSTRALIA.

Geological Survey Department, Perth.
Public Library of Western Australia, Perth.
Royal Society of Western Australia, Perth.
University of Western Australia, Perth.

ENGLAND.

British Museum Library, London.
British Museum (Natural History), South Kensington.
Cambridge Philosophical Society.
Cambridge University Library.
Conchological Society of Great Britain and Ireland.
Geological Society of London.
Geologists' Association, London.
Hill Museum, Witley, Surrey.
Imperial Institute, South Kensington.
Imperial Institute of Entomology, London.
Linnean Society of London.
Liverpool Biological Society.
Manchester Literary and Philosophical Society.
National Physical Laboratory, Teddington.
Rhodes House Library, Oxford.
Rothamsted Experimental Station, Harpenden.
Royal Botanic Gardens, Kew.
Royal Empire Society, London.
Royal Entomological Society of London.
Royal Geographical Society, London.
Royal Microscopical Society, London.
Royal Society, London.
Science Museum, South Kensington.
Zoological Museum, Tring, Herts.
Zoological Society of London.

SCOTLAND.

Edinburgh Geological Society.
Geological Society of Glasgow.
Royal Society of Edinburgh.

IRELAND.

Royal Dublin Society.
Royal Irish Academy, Dublin.

ARGENTINE REPUBLIC.

Academia Nacional de Ciencias, Cordoba.
Universidad de Buenos Aires.

AUSTRIA.

Akademie der Wissenschaften, Vienna.
Geologische Bundesanstalt, Vienna.
Naturhistorisches Museum, Vienna.
Zoologisch-Botanische Gesellschaft, Vienna.

BELGIUM.

Académie Royale de Belgique, Brussels.
Institut Solvay, Brussels.
Musée Royale d'Histoire Naturelle de Belgique, Brussels.
Société Entomologique de Belgique, Ghent.
Société Royale de Botanique de Belgique, Brussels.
Société Royale des Sciences de Liège.
Société Royale Zoologique de Belgique, Brussels.

BRAZIL.

Instituto Oswaldo Cruz, Rio de Janeiro.
Museu Paulista, Sao Paulo.

CANADA.

Canadian Geological Survey, Ottawa.
Department of Agriculture, Ottawa.
National Research Council of Canada, Ottawa.
Nova Scotian Institute of Science, Halifax.
Royal Canadian Institute, Toronto.
Royal Society of Canada, Ottawa.
University of British Columbia, Vancouver.

CEYLON.

Colombo Museum, Colombo.

CHINA.

Geological Survey of China, Peiping.
Institute of Biology, National Library of Peiping.
Metropolitan Museum of Natural History, Nanking.
Science Society of China, Nanking.
Shanghai Science Institute, Shanghai.
Sun Yatsen University, Canton.

CZECHO-SLOVAKIA.

Ceskoslovenska Botanicka Spolecnost, Prague.

DENMARK.

Conseil Permanent International pour l'Exploration de la Mer.
Dansk Naturhistorisk Forening. Copenhagen.
Kobenhavn Universitets Zoologiske Museum.
K. Danske Videnskabernes Selskab. Copenhagen.

ESTHONIA.

Universitas Tartuensis, Tartu (Dorpat).

FEDERATED MALAY STATES.

Royal Asiatic Society, Malayan Branch, Singapore.

FINLAND.

Academia Scientiarum Fennica, Helsinki.
Societas Entomologica Helsingforsiensis.
Societas Scientiarum Fennica, Helsingfors.

FRANCE.

Muséum National d'Histoire Naturelle, Paris.
Société Bourguignonne d'Histoire Naturelle et de Préhistoire, Toulouse.
Société des Sciences Naturelles de l'Ouest de la France, Nantes.
Société Entomologique de France, Paris.
Société Géologique de France, Paris.
Société Linnéenne de Bordeaux.
Societe Linnéenne de Normandie, Caen.

GERMANY.

Bayerische Akademie der Wissenschaften zu München.
Berliner Gesellschaft für Anthropologie, Ethnologie, und Urgeschichte.
Botanischer Garten und Botanisches Museum, Berlin.
Fedde, F.: Repertorium specierum novarum regni vegetabilis, Berlin.
Gesellschaft der Wissenschaften zu Göttingen.
Gesellschaft für Erdkunde zu Berlin.
K. Leopoldinische Deutsche Akademie der Naturforscher, Halle.
Naturforschende Gesellschaft, Freiburg.
Preussische Akademie der Wissenschaften, Berlin.
Senckenbergische Bibliothek, Frankfürt a. M.
Zoologisches Museum, Berlin.
Zoologisches Staatsinstitut und Zoologisches Museum, Hamburg.

HAWAIIAN ISLANDS.

Bernice Pauahi Bishop Museum, Honolulu.
Hawaiian Entomological Society, Honolulu.

HOLLAND.

Musée Teyler, Haarlem.
Rijks Herbarium, Leiden.

HUNGARY.

Hydrological Dept., Hungarian Geological Soc., Budapest.
Musée National Hongrois, Budapest.

INDIA.

Government Museum, Madras.
Geological Survey of India, Calcutta.
Royal Asiatic Society, Bombay Branch, Bombay.
Zoological Survey of India, Calcutta.

ITALY.

Laboratorio di Entomologia, Bologna.
Laboratorio di Zoologia Agraria, Milan.
Laboratorio di Zoologia Generale e Agraria, Portici.
Società di Scienze Naturali ed Economiche, Palermo.
Società Entomologica Italiana, Genova.
Società Italiana di Scienze Naturali, Milan.
Società Toscana di Scienze Naturali, Pisa.

JAPAN.

Hiroshima University.
Kyōto Imperial University.
Ohara Institute for Agricultural Research, Kurashiki.
Taihoku Imperial University.
Tokyo Imperial University.

MEXICO.

Instituto de Biologia, Chapultepec.
Instituto Geológico de Mexico.
Sociedad Cientifica "Antonio Alzate," Mexico.

NEW ZEALAND.

Auckland Institute and Museum.
Dominion Museum, Wellington.
Royal Society of New Zealand, Wellington.
Otago University Museum, Dunedin.
Philosophical Institute of Canterbury, Christchurch.

NORWAY.

Bergen Museum, Bergen.
Botanisk Museum, Oslo.
Kongelige Norske Videnskabers Selskabs, Trondhein:
Tromso Museum, Tromso.

PHILIPPINE ISLANDS.

Philippine Journal of Science, Manila.

POLAND.

Société Botanique de Pologne, Warsaw.
Société Polonaise des Naturalistes "Kopernik," Lwow.

RUSSIA.

Académie des Sciences, Leningrad.
Comité Géologique de Russie, Leningrad.
Institute of Plant Industry, Leningrad.
Siberian Mining Institute, Irkutsk.

SPAIN.

Academia de Ciencias y Artes, Barcelona.
Instituto Nacional de Segunda Ensenanza de Valencia.

SWEDEN.

Entomologiska Föreningen i Stockholm.
Geologiska Föreningen, Stockholm.
Stockholm's Högskolas Bibliotek, Stockholm.
Regia Societas Scientiarum Upsaliensis, Upsala.

SWITZERLAND.

Naturforschende Gesellschaft, Basel.
Société de Physique et d'Histoire Naturelle de Genève.
Société Neuchâteloise des Sciences Naturelles, Neuchâtel.
Société Vaudoise des Sciences Naturelles, Lausanne.
Zentralbibliothek, Zürich.

UNION OF SOUTH AFRICA.

Albany Museum, Grahamstown.
Geological Society of South Africa, Johannesburg.
Royal Society of South Africa, Cape Town.
South African Museum, Cape Town.
South African Association for the Advancement of Science, Johannesburg.

UNITED STATES.

Academy of Natural Sciences of Philadelphia.
Academy of Science of St. Louis.
American Academy of Arts and Sciences, Boston.
American Chemical Society, Columbus, O.
American Geographical Society, New York.
American Microscopical Society, Manhattan, Kans.
American Museum of Natural History, New York.
American Philosophical Society, Philadelphia.
Arnold Arboretum, Jamaica Plain, Mass.
Biological Survey of the Mount Desert Region, Bar Harbour, Me.
Boston Society of Natural History, Boston, Mass.
Brooklyn Institute of Arts and Sciences.
California Academy of Sciences, San Francisco.
Californian State Mining Bureau, San Francisco.
California, University of, Berkeley, Cal.
Chicago Academy of Sciences.
Citrus Experiment Station, Riverside, Cal.
Connecticut State Library, Hartford, Conn.
Cornell University, Ithaca, N.Y.
Denison Scientific Association, Granville, O.
Field Museum of Natural History, Chicago, Ill.
Franklin Institute of the State of Pennsylvania, Philad.
Harvard Museum of Comparative Zoology, Cambridge, Mass.
Illinois State Natural History Survey, Urbana, Ill.
Illinois University Library, Urbana, Ill.
Indiana Academy of Science, Indianapolis.
Johns Hopkins University, Baltimore, Md.
Kansas University, Lawrence, Kans.
Marine Biological Laboratory, Wood's Hole, Mass.
Maryland Geological Survey, Baltimore, Md.
Michigan University, Chicago.
Missouri Botanical Garden Library, St. Louis, Mo.
Missouri, University of, Columbia.
National Academy of Science, Washington, D.C.
National Geographic Society, Washington, D.C.
New York Academy of Sciences, New York.
New York Public Library.
New York State Library, Albany, N.Y.
Ohio State University Library, Columbus, O.
Princeton University, Princeton, N.J.
San Diego Society of Natural History, San Diego, Cal.
Smithsonian Institution and Bureau of Ethnology, Washington.
United States Department of Agriculture, Washington, D.C.
United States Geological Survey, Washington, D.C.
United States National Museum, Washington, D.C.
Wagner Free Institute of Science, Philadelphia, Pa.
Washington University, St. Louis, Mo.
West Virginia University, Morgantown, W. Va.
Yale University Library, New Haven, Conn.

URUGUAY.

Museo de Historia Natural, Montevideo.

LIST OF FELLOWS, MEMBERS, ETC.

AS EXISTING ON SEPTEMBER 30, 1934.

Those marked with an asterisk (*) have contributed papers published in the Society's Transactions. Those marked with a dagger (†) are Life Members.

Any change in address or any other changes should be notified to the Secretary.

***Note.*—The publications of the Society will not be sent to those whose subscriptions are in arrear.**

Date of Election.

Honorary Fellows.

1910. *Bragg, Sir W. H., O.M., K.B.E., M.A., D.C.L., LL.D., D.Sc., F.R.S., Director of the Royal Institution, Albemarle Street, London (Fellow 1886).
1926. *Chapman, F., A.L.S., National Museum, Melbourne.
1898. *Meyrick, E. T., B.A., F.R.S., F.Z.S., Thornhanger, Marlborough, Wilts, England.
1894. *Wilson, J. T., M.D., Ch.M., F.R.S., Professor of Anatomy, Cambridge University, England.

Fellows.

1926. Abell, L. M., Chapman Camp, British Columbia.
1925. Adey, W. J., 32 High Street, Burnside, S.A.
1927. *Alderman, A. R., M.Sc., F.G.S., West Terrace, Kensington Gardens, S.A.
1931. Andrew, Rev. J. R., Methodist Mission, Salamo, via Samarai, Papua.
1929. Angel, Frank M., 34 Fullarton Rd., Parkside.
1895. †*Ashby, Edwin, F.L.S., M.B.O.U., Blackwood, S.A.—**Council,** 1900-19; **Vice-President,** 1919-21.
1902. *Baker, W. H., Ningana Avenue, King's Park, S.A.
1933. *Barnes, T. A. B.Sc., 13 Leah Street, Forestville.
1926. Beck, B. B., 127 Fullarton Road, Myrtle Bank, S.A.
1932. Begg, P. R., B.D.Sc., L.D.S., 219 North Terrace, Adelaide.
1928. Best, R. J., M.Sc., A.A.C.I., Waite Agricultural Research Institute, Glen Osmond.
1928. *Best, Mrs. E. W., M.Sc., Claremont, Glen Osmond.
1931. Birch, H. McI., M.R.C.S., M.R.C.P., D.P.M., Mental Hospital, Parkside.
1930. Birks, W. R., B.Sc., 7 Kensington Road, Kensington.
1934. Black, E. C., M.B., B.S., Magill Road, Tranmere.
1907. *Black, J. M., A.L.S., 82 Brougham Place, North Adelaide—**Sir Joseph Verco Medal,** 1930; **Council,** 1927-1931; **President,** 1933-34; **Vice-President,** 1931-33.
1924. Browne, J. W., B.Ch., 169 North Terrace, Adelaide.
1923. Burdon, Roy S., B.Sc., University of Adelaide.
1921. Burton, R. J., c/o P.O., Kalgoorlie, W.A.
1922. *Campbell, T. D., D.D.Sc., Dental Dept., Adelaide Hospital, Frome Road, Adelaide—**Rep.-Governor** ,1932-33; **Council,** 1928-32; **Vice-President,** 1932-34; **President,** 1934-.
1907. *Chapman, R. W., C.M.G., M.A., B.C.E., F.R.A.S., Professor of Engineering and Mechanics, University, Adelaide—**Council,** 1914-22.
1931. *Chewings, Chas., Ph.D., F.G.S., "Alverstroke," Claremont Road, Glen Osmond.
1929. Christie, W., M.B., B.S., Education Department, Flinders Street, Adelaide—**Treasurer,** 1933-.
1930. Clarke, G. H., B.Sc., Agricultural College, Roseworthy.
1895. *Cleland, John B., M.D., Professor of Pathology, University, Adelaide—**Sir Joseph Verco Medal,** 1933; **Council,** 1921-26, 1932-; **President,** 1927-28; **Vice-President,** 1926-27.
1930. Collins, F. V., B.V.Sc., Green Road, Woodville.
1930. *Colquhoun, T. T., M.Sc., University, Adelaide.
1907. *Cooke, W. T., D.Sc., A.A.C.I., Lecturer, University of Adelaide.
1929. *Cotton, Bernard C., S.A. Museum, Adelaide.
1924. de Crespigny, C. T. C., D.S.O., M.D., F.R.C.P., 219 North Terrace, Adelaide.
1929. Davidson, James, D.Sc., Waite Agricultural Research Institute, Glen, Osmond—**Council,** 1932-.
1928. Davies, J. G., B.Sc., Ph. D., Waite Agricultural Research Institute, Glen Osmond.
1927. *Davies, Prof. E. Harold, Mus.Doc., The University, Adelaide.
1930. Dix, E. V., Glynde Road, Firle.
1915. *Dodd, Alan P., Prickly Pear Laboratory, Sherwood, Brisbane.
1932. Dunstone, H. E., M.B., B.S., J.P., 124 Payneham Road, St. Peters.
1921. Dutton, G. H., B.Sc., 18 Austral Terrace, Malvern.
1931. Dwyer, J. M., M.B., B.S., Adelaide Hospital.
1933. Eardley, Miss C. M., B.Sc., 68 Wattle Street, Fullarton Estate.
1902. *Edquist, A. G., 19 Farrell Street, Glenelg.
1918. *Elston, A. H., F.E.S.. "Llandyssil," Aldgate.

Date of Election.

1925. ENGLAND, H. N., B.Sc., Commonwealth Research Station, Griffith, N.S.W.
1932. *EVANS, J. W., M.A., Waite Agricultural Research Institute, Glen Osmond.
1917. *FENNER, CHAS. A. E., D.Sc., 42 Alexander Avenue, Rose Park—**Rep.-Governor**, 1929-31; **Council**, 1925-28; **President**, 1930-31; **Vice-President**, 1928-30; **Secretary**, 1924-25; **Treasurer**, 1932-33; **Editor**, 1934-.
1927. *FINLAYSON, H. H., The University of Adelaide.
1929. FRENEY, M. RAPHAEL.
1929. FRENEY, M. RICHARD.
1931. FREWIN, O. W., M.B., B.S., Woodville.
1923. *FRY, H. K., D.S.O., M.B., B.S., B.Sc., Glen Osmond Road, Parkside—**Council**, 1933-.
1930. GARRETT, S. D., B.A., Waite Agricultural Research Institute, Glen Osmond.
1932. *GIBSON, E. S. H., B.Sc., 297 Cross Roads, Clarence Gardens.
1919. †GLASTONBURY, O. A., Adelaide Cement Co., Brookman Buildings, Grenfell Street.
1923. GLOVER, C. R. J., Stanley Street, North Adelaide.
1927. GODFREY, F. K., Robert Street, Payneham, S.A.
1934. GOODHART, W. W., 7 Harrow Road, St. Peters.
1904. GORDON, DAVID, 72 Third Avenue, St. Peters.
1925. †GOSSE, J. H., Gilbert House, Gilbert Place, Adelaide.
1880. *GOYDER, GEORGE, A.M., B.Sc., F.G.S., 232 East Terrace, Adelaide.
1910. *GRANT, KERR, M.Sc., Professor of Physics, University, Adelaide—**Council**, 1912-15.
1933. GRAY, JAMES H., M.B., B.S., Adelaide Hospital.
1930. GRAY, JAMES T., Orroroo, S.A.
1933. GREAVES, H., Director, Botanic Garden, Adelaide.
1904. GRIFFITH, H., Hove, Brighton.
1934. GUNTER, REV. H. A., 33 Kensington Terrace, Norwood.
1916. HACKETT, W. CHAMPION, 35 Dequetteville Terrace, Kent Town.
1927. *HACKETT, Dr. C. J., 196 Prospect Road, Prospect, S.A.
1922. *HALE, H. M., The Director, S.A. Museum, Adelaide—**Council**, 1931-34; **Vice-President**, 1934-.
1930. HALL, F. J., Adelaide Electric Supply Coy., Ltd., Adelaide.
1922. *HAM, WILLIAM, F.R.E.S., 112 Edward Street, Norwood.
1916. †HANCOCK, H. LIPSON, A.M.I.C.E., M.I.M.M., A.Am.I.M.E., Bewdley, 66 Beresford Road, Bellevue Hill, Rose Bay, Sydney.
1924. HAWKER, Captain C. A. S., M.A., M.H.R., Dillowie, Hallett, South Australia.
1923. HILL, FLORENCE McCOY M., B.S., M.D., Elizabeth Street, Sydney, N.S.W.
1927. HOLDEN, E. W., B.Sc., Dequetteville Terrace, Kent Town, S.A.
1933. HOSKING, H. C., B.A., 24 Northcote Terrace, Gilberton.
1929. HOSKING, JOHN W., 77 Sydenham Road, Norwood.
1930. HOSKING, J. S., B.Sc., Waite Agricultural Research Institute, Glen Osmond.
1924. *HOSSFELD, PAUL S., M.Sc., Office of Home and Territories, Canberra.
1883. *HOWCHIN, PROFESSOR WALTER, F.G.S., "Stonycroft," Goodwood East—**Sir Joseph Verco Medal**, 1929; **Rep.-Governor**, 1901-22; **Council**, 1883-84, 1887-89, 1890-94, 1902-; **President**, 1894-96; **Vice-President**, 1884-87, 1889-90, 1896-1902; **Editor**, 1883-88, 1893-94, 1895-96, 1901-1933.
1928. HURCOMBE, Miss J. C., 95 Unley Road, New Parkside.
1928. IFOULD, PERCY, Kurralta, Burnside.
1918. *ISING, ERNEST H., c/o Comptroller's Office, S.A. Railways, Adelaide—**Council**, 1934-.
1918. *JENNISON, REV. J. C., Goolwa.
1910. *JOHNSON, E. A., M.D., M.R.C.S., Town Hall, Adelaide.
1934. JOHNSTON, J., A.S.A.S.M., 32 Fisher Street, Norwood.
1921. *JOHNSTON, PROFESSOR T. HARVEY, M.A., D.Sc., University, Adelaide—**Rep.-Governor**, 1927-29; **Council**, 1926-28; **Vice-President**, 1928-31; **President**, 1931-32.
1929. JOHNSTON, W. C., Government Agricultural Inspector, Riverton.
1920. *JONES, PROFESSOR F. WOOD, M.B., B.S., M.R.C.S., L.R.C.P., D.Sc., F.R.S., University, Melbourne—**Rep.-Governor**, 1922-27; **Council**, 1921-25; **President**, 1926-27; **Vice-President**, 1925-26.
1918. KIMBER, W. J., 28 Second Avenue, Joslin.
1933. *KLEEMAN, A. W., B.Sc., 12 Ningara Avenue, Kings Park.
1915. *LAURIE, D. F., Agricultural Department, Flinders Street, Adelaide.
1930. LE MESSURIER, D. H., B.Sc., 133 Mills Terrace, North Adelaide.
1884. LENDON, A. A., M.D., M.R.C.S., 66 Brougham Place, North Adelaide.
1922. LENDON, GUY A., M.B., B.S., M.R.C.P., North Terrace.
1925 LEWIS, A. J., M.D., B.S., The Maudsley Hospital, Denmark Hill, London, S.E. 5.
1930. LOUWYCK, REV, N. H., The Rectory, Yankalilla.
1922. *MADIGAN, C. T., M.A., B.E., D.Sc., F.G.S., University of Adelaide—**Council**, 1930-33; **Vice-President**, 1933-.
1923. MARSHALL, J. C.. Darrock, Payneham.

Date of Election.

1928. *Maegraith, B. G., M.B., B.S., Magdalen College, Oxford, England.
1930. Magarey, Miss K. de B., B.A., B.Sc., 38 Winchester Street, Malvern.
1932. Mann, E. A., C/o Bank of Adelaide, Adelaide.
1929. Martin, F. C., M.A., Technical High School, Thebarton.
1905. *Mawson, Sir Douglas, D.Sc., B.E., F.R.S., Professor of Geology, University, Adelaide **Sir Joseph Verco Medal,** 1931; **Rep.-Governor,** 1933; **President,** 1924-25; **Vice-President,** 1923-24, 1925-26.
1919. Mayo, Helen M., M.D., 47 Melbourne Street, North Adelaide.
1920. Mayo, Herbert, LL.B., K.C., 16 Pirie Street, Adelaide.
1934. McCloughry, C. L., B.E., A.M.I.E. (Aust.), 271 Melbourne Street, North Adelaide.
1929. McLaughlin, E., M.B., B.S., M.R.C.P., Adelaide Hospital.
1907. Melrose, Robert T., Mount Pleasant.
1930. Miller, J. I., 18 Ralston Street, Largs Bay.
1925. †Mitchell, Professor Sir William, K.C.M.G., M.A., D.Sc., The University, Adelaide.
1930. Mitchell, Miss U. H., B.Sc., Presbyterian Girls' College, Glen Osmond.
1930. Mitchell, M. L., B.Sc., Fitzroy Terrace, Prospect.
1924. Morison, A. J., Deputy Town Clerk, Town Hall, Adelaide.
1930. Morris, L. G., Beehive Buildings, King William Street, Adelaide.
1925. †Murray, Hon. Sir George, K.C.M.G., B.A., LL.M., Magill, S.A.
1925. North, Rev. Wm. O., Methodist Manse, Netherby.
1930. Ockenden. G. P., Public School, Streaky Bay, S.A.
1932. Oliphant, H. R., University, Adelaide.
1913. *Osborn, T. G. B., D.Sc., Professor of Botany, University, Sydney—**Council,** 1915-20, 1922-24; **President,** 1925-26; **Vice-President,** 1924-25, 1926-27.
1927. Paltridge, T. B., B.Sc., Koonamore, via Waukaringa, S.A
1929. Pank, Harold G., 75 Rundle Street, Adelaide.
1929. Paull, Alec. G., B.A., B.Sc., 10 Milton Avenue, Fullarton Estate.
1924. Pearce, C., Happy Valley Reservoir, O'Halloran Hill.
1924. Perkins, Professor A. J., Director of Agriculture, Flinders Street, Adelaide.
1928. Phipps, Ivan F., Ph.D., Waite Agricultural Research Institute, Glen Osmond.
1926. *Piper, C. S., M.Sc., Waite Agricultural Research Institute, Glen Osmond.
1925. *Prescott, Professor J. A., D.Sc., A.I.C., Waite Agricultural Research Institute, Glen Osmond—**Council,** 1927-30; **Vice-President,** 1930-32; **President,** 1932-33.
1926. Price, A. Grenfell, C.M.G., M.A., Litt.D., F.R.G.S., St. Mark's College, North Adelaide.
1907. †*Pulleine Robert H., M.B., Ch.M., North Terrace, Adelaide—**Council,** 1914-19, 1932-; **President,** 1922-24; **Vice-President,** 1912-14, 1919-22, 1924-25; **Secretary,** 1909-12, 1925-30.
1925. Richardson, Professor A. E. V., M.A., D.Sc., "Urrbrae," Glen Osmond, S.A.
1926. *Riddell, P. D., Technical College, Newcastle, N.S.W.
1911. *Roach, B. S., 81 Kent Terrace, Kent Town—**Treasurer,** 1920-32.
1925. Rogers, L. S., B.D.Sc., 192 North Terrace, Adelaide.
1905. *Rogers, R. S., M.A., M.D., F.L.S., 52 Hutt Street, Adelaide—**Council,** 1907-14, 1919-21; **President,** 1921-22; **Vice-President,** 1914-19, 1922-24.
1931. Rudd, E. A., 10 Church Street, Highgate.
1928 Scott, A. E., B.Sc., Waite Agricultural Research Institute, Glen Osmond.
1934. Shinkfield, R. C., Meteorological Bureau, West Terrace, Adelaide.
1930. Schneider, M., M.B., B.S., 175 North Terrace, Adelaide.
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1929. Tee, Sidney F., Adelaide Hospital.
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1923. *Tindale, N. B., B.Sc., South Australian Museum, Adelaide.

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GENERAL INDEX.

[Generic and specific names in italics indicate that the forms described are new to science.]

ERRATA.

P. 86. "Folsom (110A)" should be "Folsom (13)."

P. 109. "Family Entomobryidea" should be "Family Entomobryoidea."

P. 246. "Fiscus platypoda" should be "Ficus platypoda."

P. 246. "Mastacomys fiscus" should be "Mastacomys fuscus."

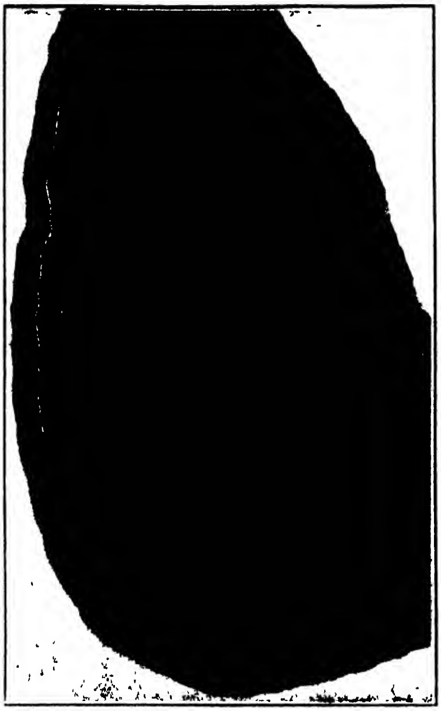

Fig. 2

Fig. 3

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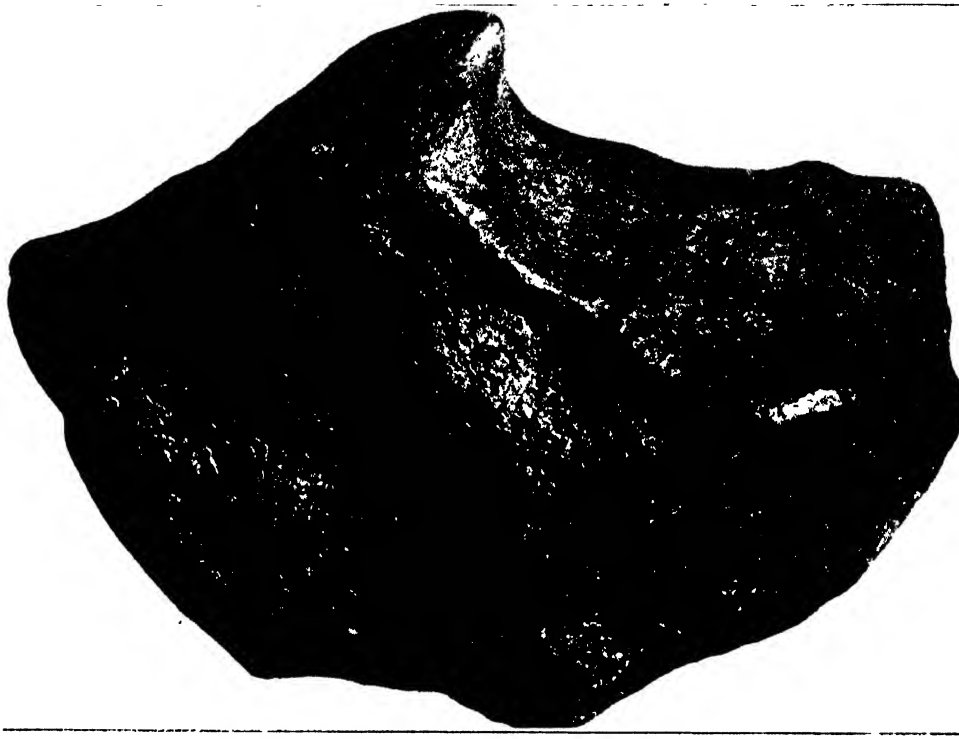

Fig. 1. The Arltunga Meteorite. About / natural size.

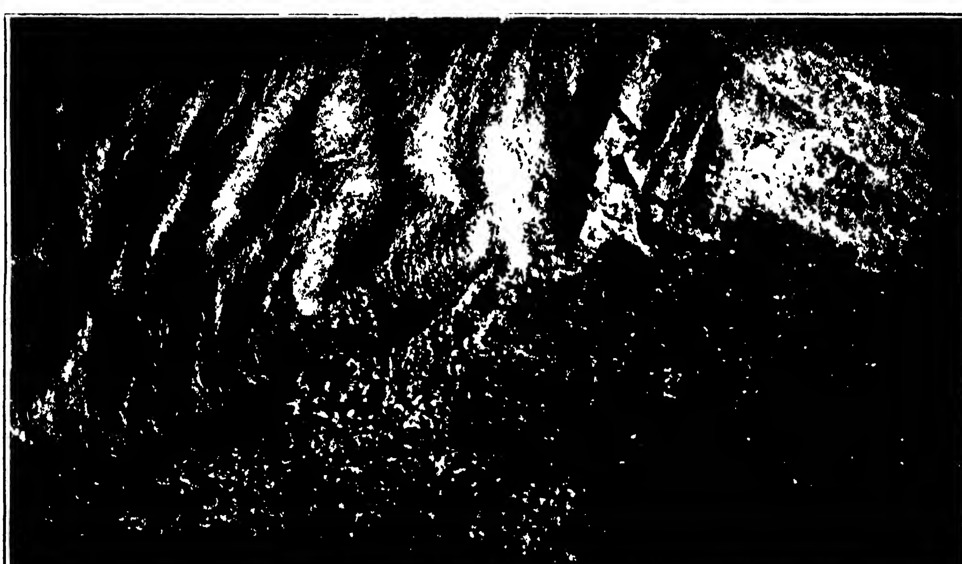

Fig. 2. Portion of the surface of the Karoonda Meteorite. Magnification, x 7/8.

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Fig. 1. The natural fracture surface of the Karoonda Meteorite. Magnification × [illegible]

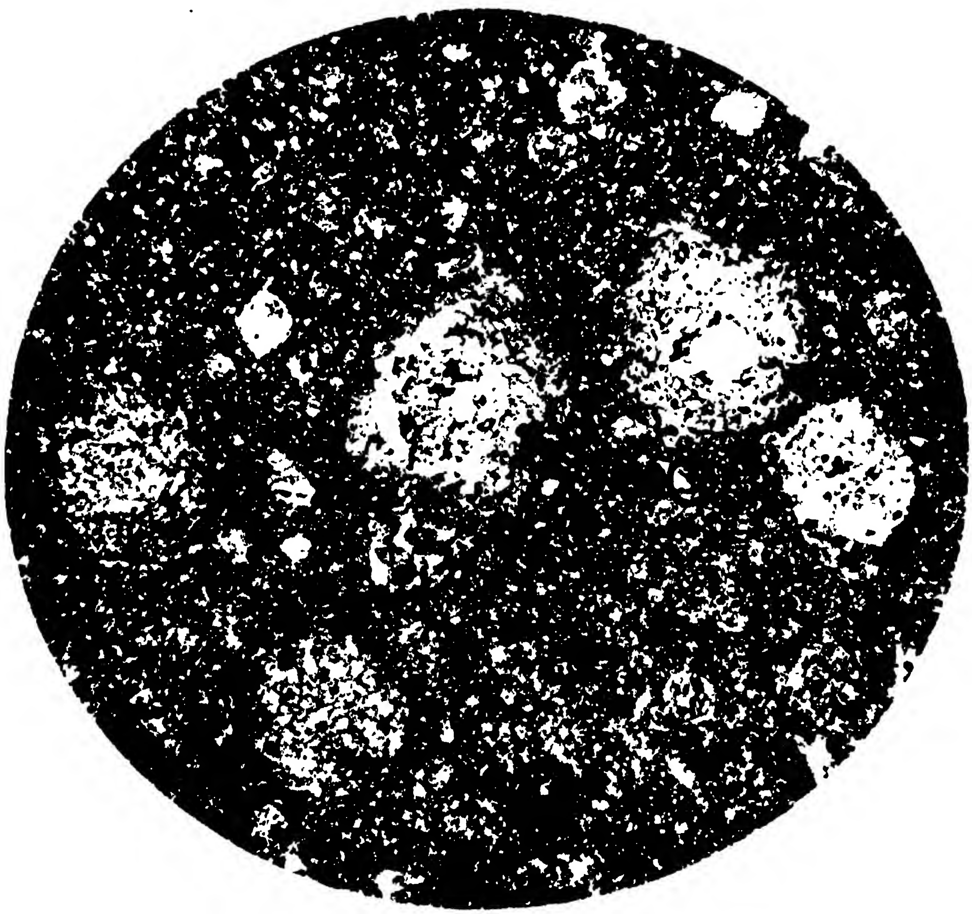

Fig. 2. Microscopic structure of the Karoonda Meteorite. Magnification: × 15

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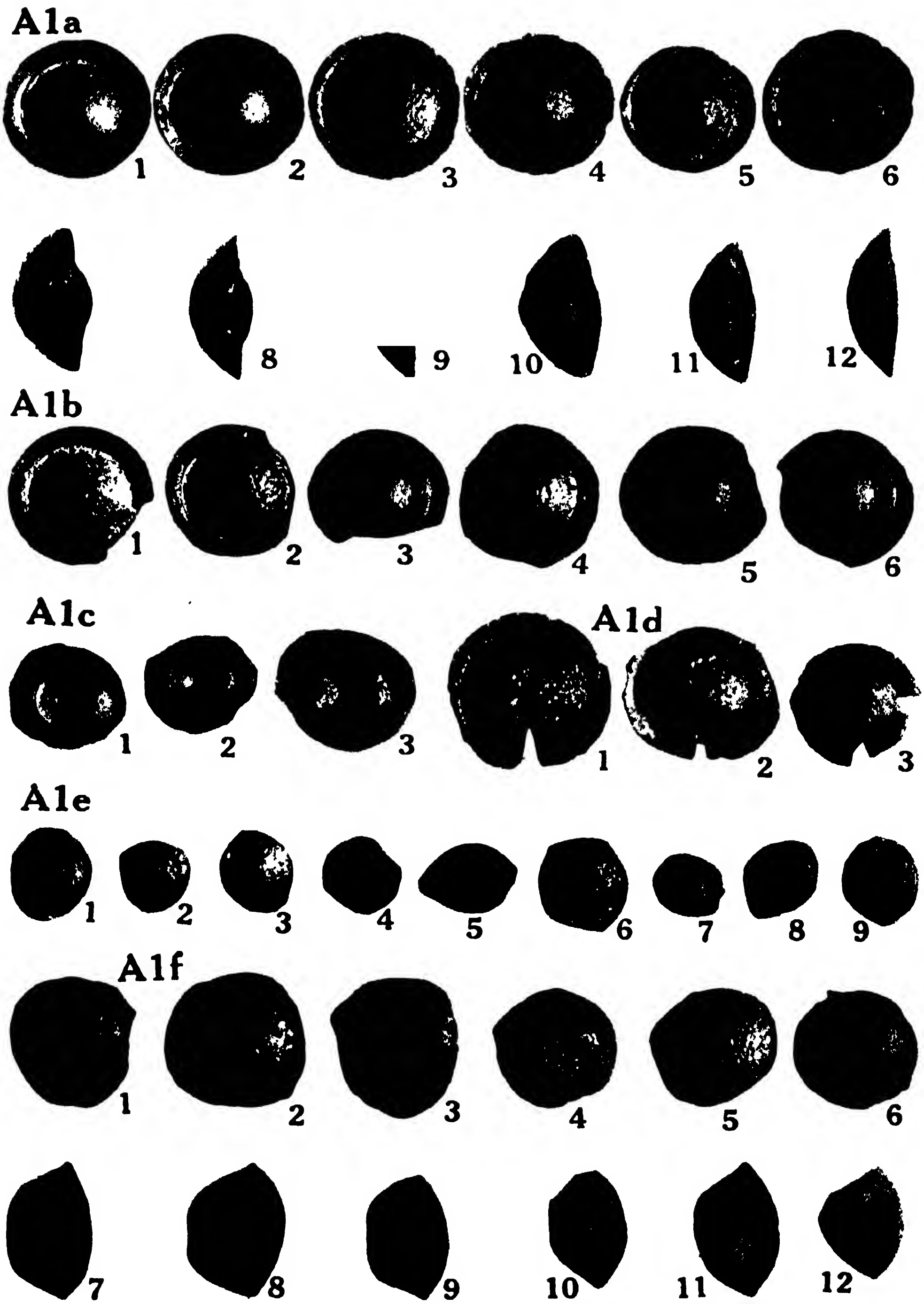

Australites. Button types, natural size, top, bottom and side views, as described in the context.

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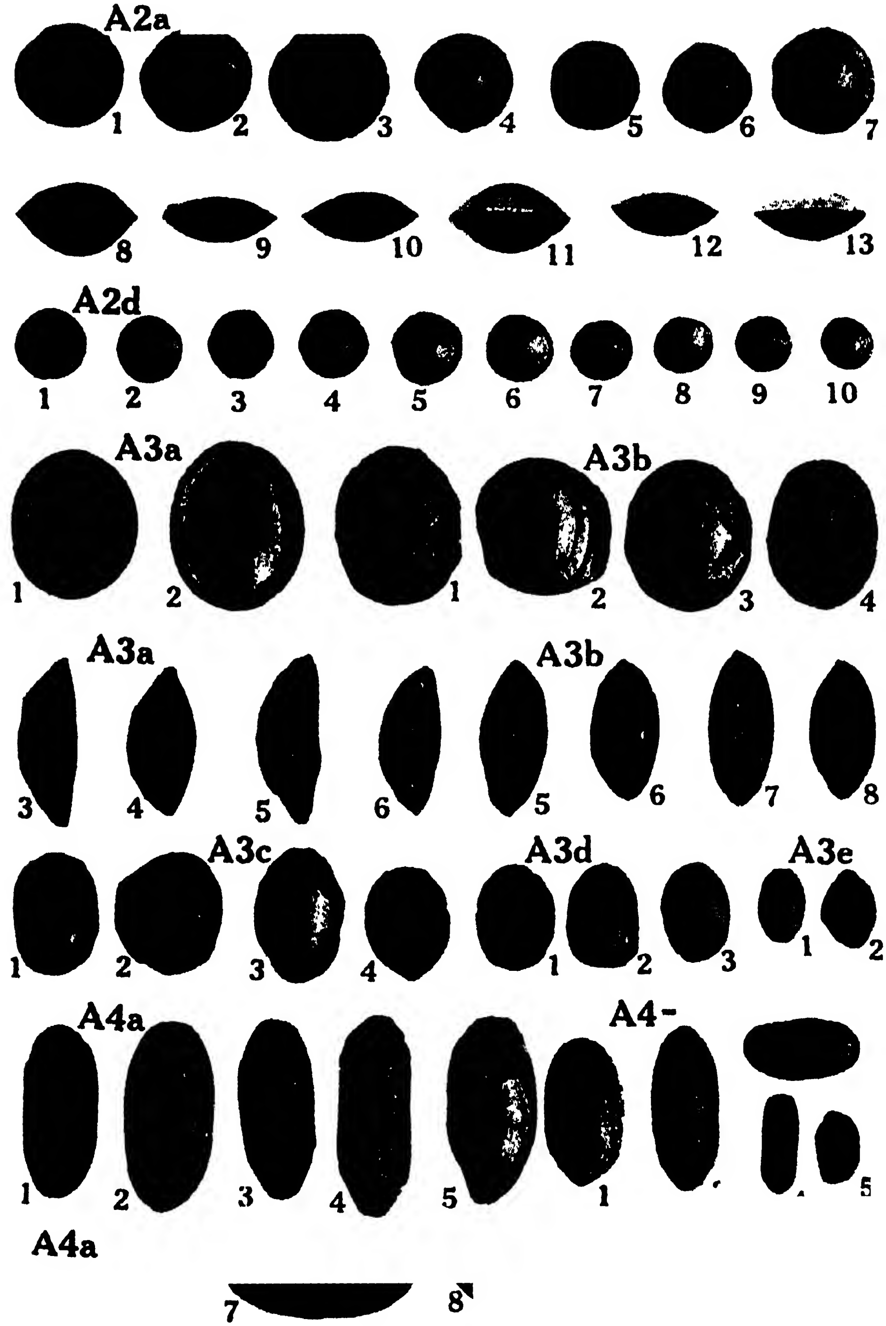

Australites. Lens, oval, and boat types, natural size, top, bottom, and side views, as described in the context.

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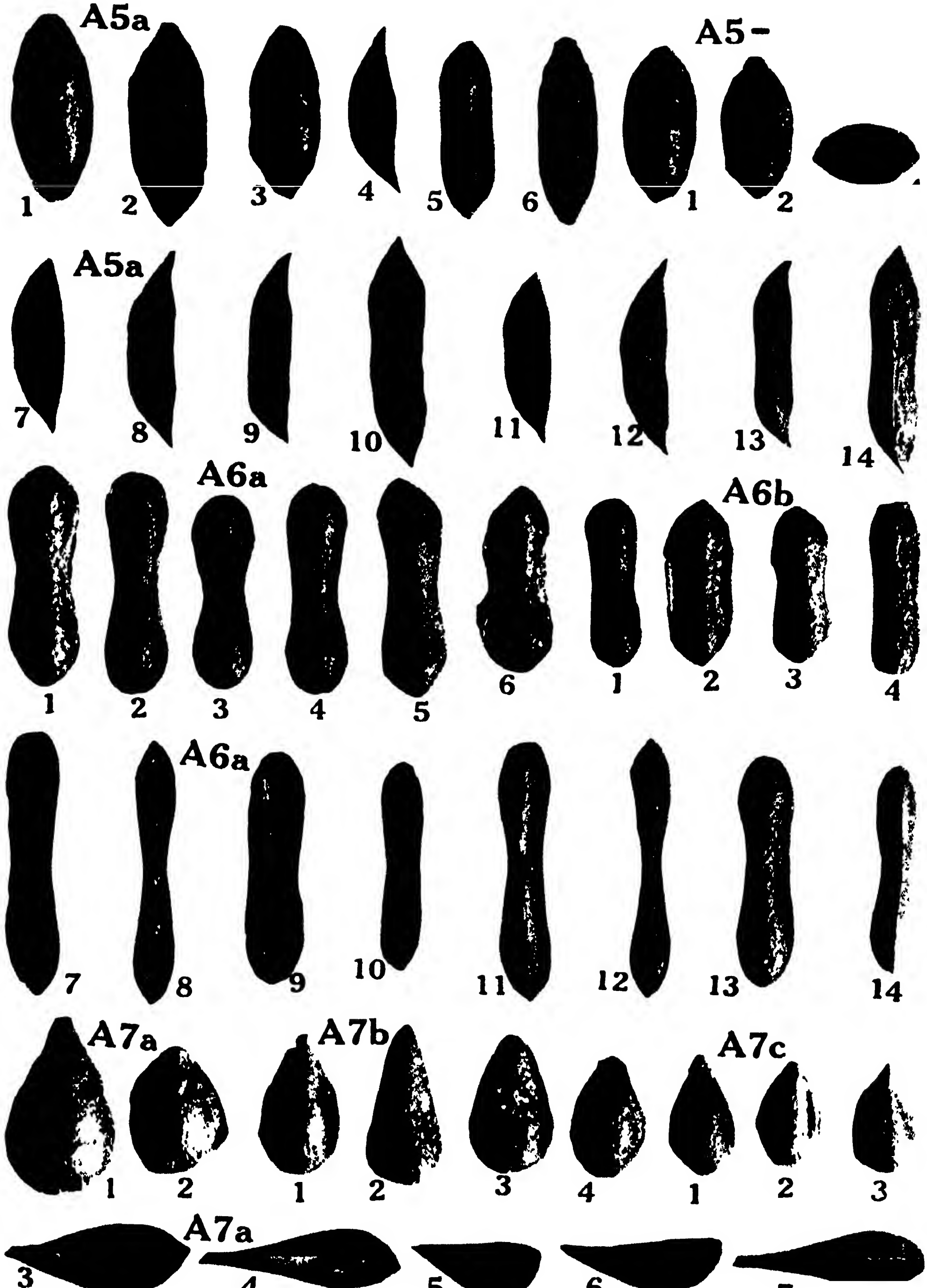

Australites. Canoe, dumbbell, and teardrop types, natural size; top, bottom and side views, as described in the context

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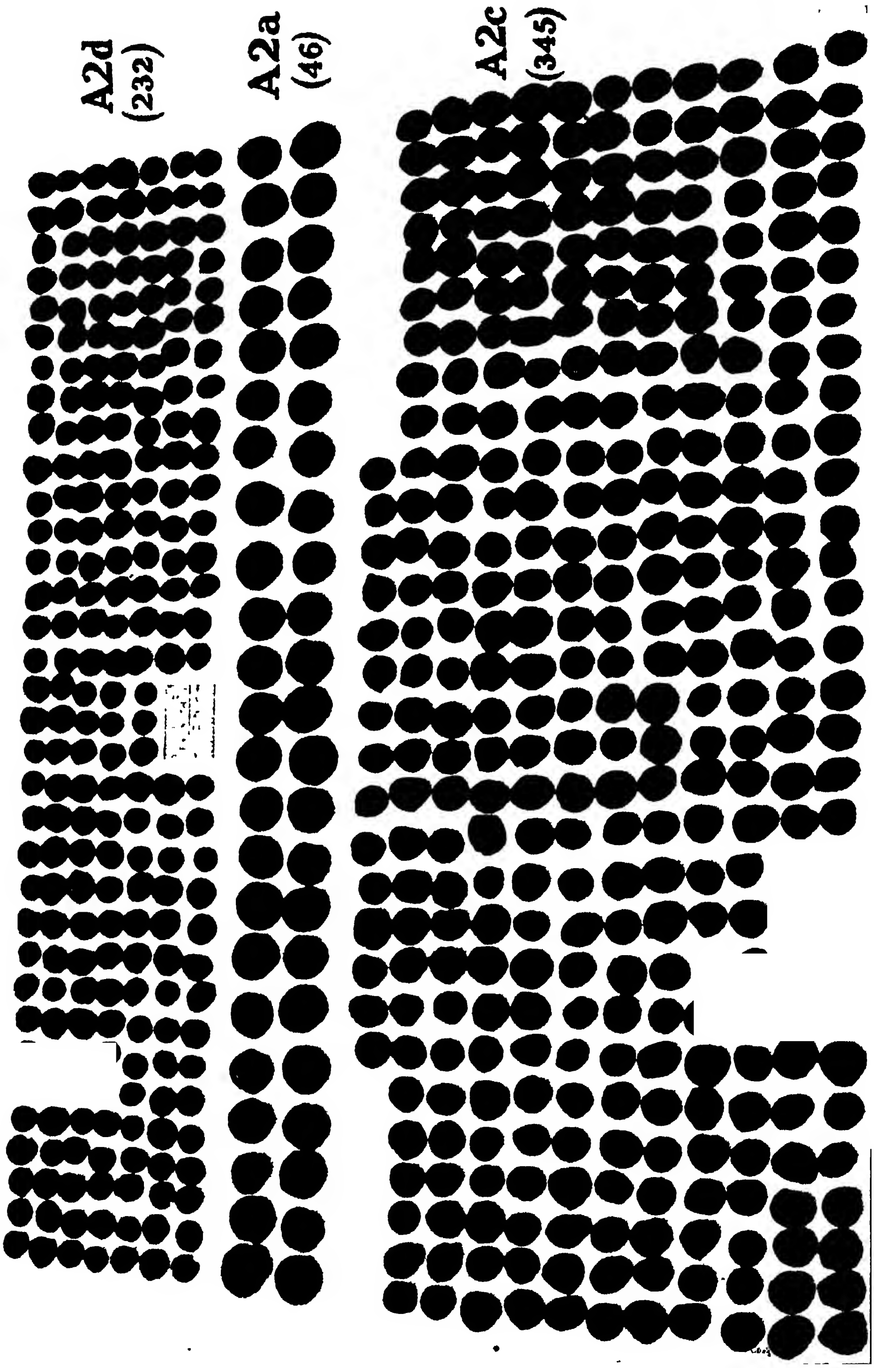

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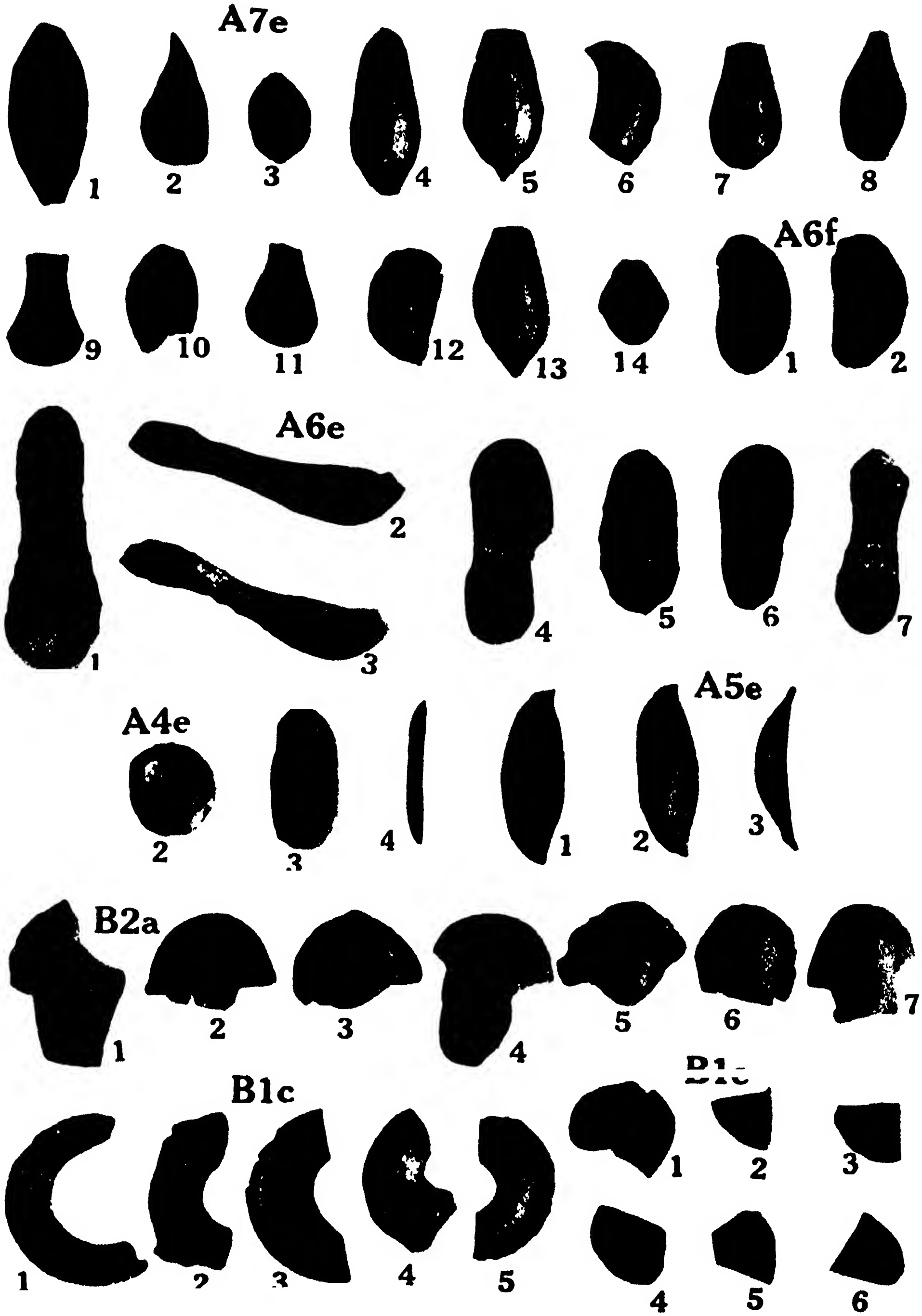

Australites. Various unusual and aberrant forms and fragments, as described in the context.

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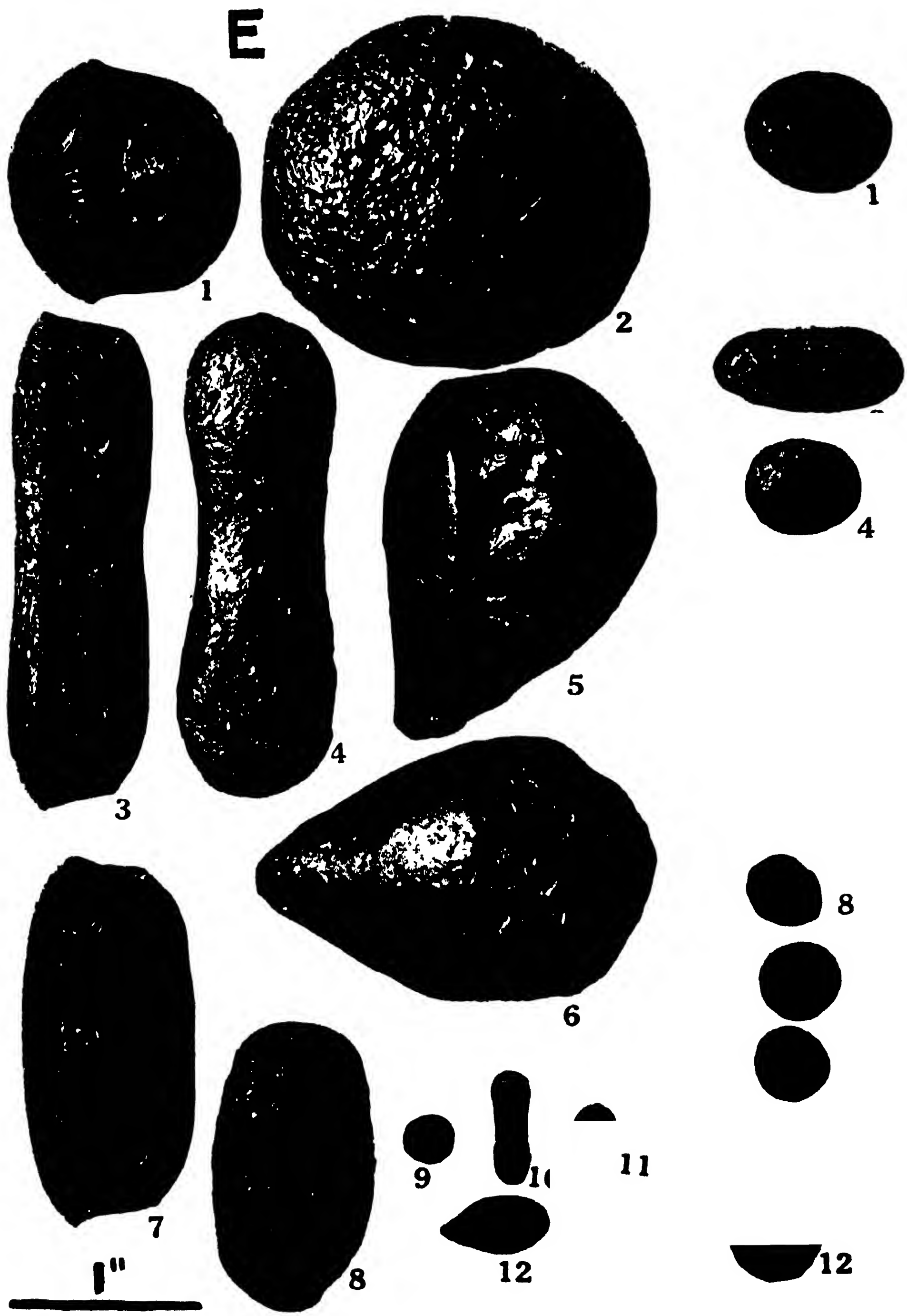

Various types of Australites. Natural size. The larger specimens do not belong to the Shaw collection, but illustrate various points in the context.

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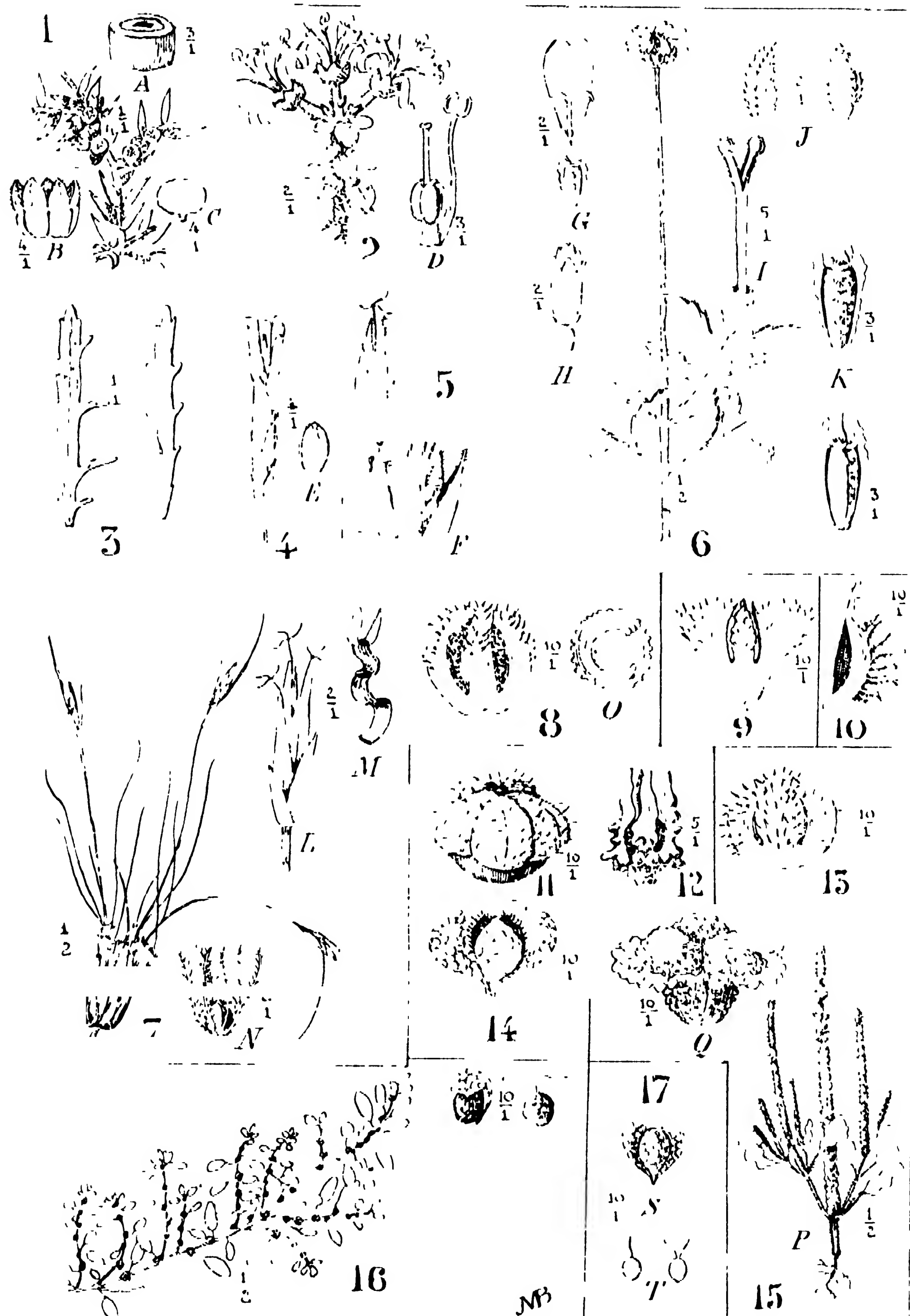

1. *Melaleuca monticola* 2. *Phebalium brachyphyllum* 3. *Pluchea dentex.* 4. *Tetraria monocarpa* 5. *T. capillaris.* 6 *Wedelia verbesinoides.* 7. *Schoenus deformis* 8 *Chenopodium pumilio.* 9. *Ch carinatum.* 10. *Ch. cristatum.* 11. *Ch. melanocarpum* 12 *Ch. atriplicinum.* 13. *Ch. rhadinostachyum* 14 *Ch. plantaginellum.* 15. *Ch. simulans* 16. *Ch. myriocephalum.* 17. *Ch Blackianum.*

1. *Cephalostigma fluminale.* 2. *Sarcozona Pulleinei.* 3. *Calostemma purpureum*
4. *Solanum centrale*